The FOUNDRY

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Castings Bring Water To Quench the Thirst

THE often quoted lines from Samuel Taylor Coleridge's *Ancient Mariner*, "Water, water everywhere nor any drop to drink," indicates the requirements of the human body for that beverage. In years gone by, the much ridiculed town pump supplied the water for the inhabitants of many towns. While the citizens of Bourbon, Ind., recently declared a special holiday to dedicate a monument to the old town pump, the fact remains that there are few villages in which that relic still flourishes. Modern and up-to-date cities, towns and villages, have drinking fountains located at convenient places on their thoroughfares where the citizens may quench their thirst. Fountains also are to be found in buildings, both public and commercial, schools, parks and in fact at almost every place that people gather, whether it be in commercial or frivolous pursuits. In many theatres and public buildings, the drinking fountains are spots of especial beauty. Castings play an important part in the construction of these watering places. The bowl into which the waste water falls is made of cast iron and if a standard is used that generally is of the same material. Many of the fixtures also are castings.

Many Castings Are Used in the Construction of Drinking Fountains Found in Public Places

Find Where Castings Can Be Sold

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Specializes in Die Blocks

Special Molding and Coremaking Meth- and Accuracy Are Demanded To

TWELVE years ago two young men in Detroit decided that a promising and lucrative future awaited the person who could make better die blocks than those at that time in use among builders of automotive vehicles. To make assurance doubly sure they decided that any person who could guarantee delivery of these castings in a shorter time than that prevailing up to that period, could secure practically all the business within a reasonable shipping radius. Also, and as a final touch, they decided that castings and service of this kind warranted a special price, a premium on quality and time.

Fig. 1—Steel from the Electric Furnace Is Shanked and Poured by Hand

In the light of experience over the past 12 years their decisions seem to have been justified. They began operations in one part of an old building down near the river and originally devoted to the manufacture of nuts and bolts. The building was long and narrow and dark and old fashioned but it served the purpose for several years during which the business spread out to such an extent that all the floor space was required for molding the castings. Empty flasks were stacked on the sidewalk of a street that no longer has any pedestrian traffic. When the street space was exhausted, a hoist was rigged at one side of the building and the remainder of the flasks were piled on the roof. The daily heat in the foundry gradually rose from 2 or 3 to 150 tons.

Uses Shortcut Methods

A shortcut method of making the patterns and molds, a liberal payment system that encourages the men to work fast and—if necessary—for overtime periods, a fleet of trucks in which the castings sometimes are shipped before they fairly have cooled, a rigid promise and delivery schedule, these and perhaps one or two others, constitute the factors responsible for a heavy tonnage of die castings in the Detroit district gravitating to the foundry of the Detroit Gray Iron Foundry Co., located on a corner property bounded on the south by Wight and appropriately enough on the west by Iron street.

Recent erection and complete modern equipment of a new foundry close to the original building would seem to indicate that on the third count in the original program the anticipation of the promoters has been fulfilled.

Future disposition of the old foundry is problematical, but in the meantime it is utilized to a considerable extent. The greater part of the molding floor still is in use. All the castings from both foundries are cleaned in the original cleaning room which has been enlarged by the removal of the core ovens. Part of the floor has been cleared away and an electric furnace made by the Pittsburgh Electric Furnace Co., Pitts-

for Automotive Industry

ods Are Used in Foundry Where Speed Meet Short Period Delivery Schedules

burgh, has been installed. This section of the foundry is devoted to the production of alloy castings, both gray iron and steel.

Small and medium size castings are cleaned in three tumbling barrels made by the Whiting Corp., Harvey, Ill. Large castings are cleaned in a sandblast chamber erected and equipped by the Pangborn Corp., Hagerstown, Md. A number of portable grinding machines supplied by the United States Electrical Tool Co., Cincinnati, are employed in trimming the large castings. Pneumatic chipping tools employed extensively in the cleaning room were made by the Cleveland Pneumatic Tool Co., Cleveland.

Push the Work Along

Immediately after the castings have been poured, or to be strictly accurate, immediately after they have cooled to a point where they may be handled with safety, they are removed from the sand and loaded on low trucks running on an industrial railroad with branches extending to several points in the plant where they may be served by the cranes. Most of the castings attain atmospheric temperature before they are shipped, but many are taken away while still sensibly warm and—as previously stated—occasionally one is shipped while in a condition to boil the rain drops that fall upon it during the journey. With all the convenience of the new foundry the owners confidently expect to boost speed and service another notch.

The spur from the railroad which serves the plant extends through a long, narrow yard between the new and the old building. This yard is spanned by a crane which unloads the pig iron, gray iron and steel scrap with a magnet and the sand, coke and limestone with a grab bucket. In accordance with latter day practice based on easy and quick transportation, little or no reserve stock is kept on hand. The sand sheds hold a sufficient supply for a month, but the iron and coke are transferred daily directly from the railroad cars to the charging floors of both the old and the new foundries. The platforms are joined by an overhead gangway or narrow bridge which spans the railroad track below.

Iron is melted in three 72-inch diameter cupolas made by the Whiting Corp., Harvey, Ill. Two of these cupolas are located in the old foundry where they have been used alternately, one for each day's heat. The third cupola is in the northwest corner of the new foundry and eventually may occupy a position near the center of the building when the building shall be extended to the north.

The new building of brick, steel, glass and concrete is practically fireproof. In layout and construction it conforms to the best standards of

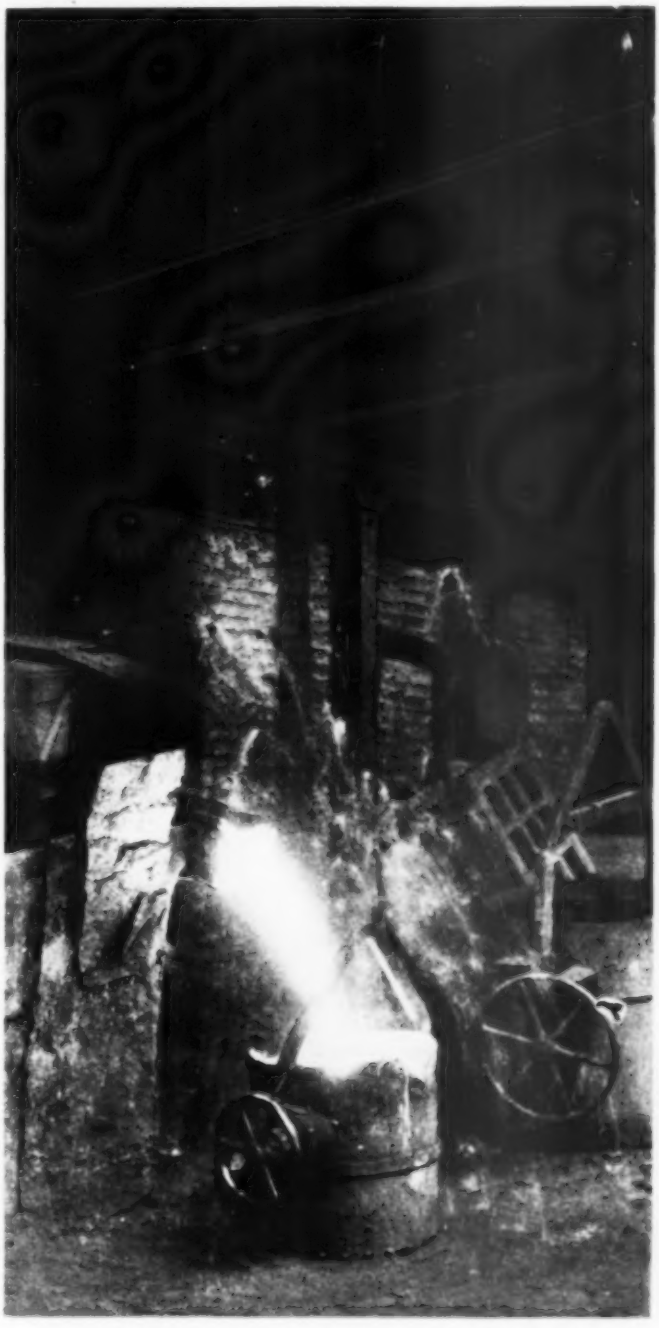


Fig. 2—Filling a Ladle in Front of One of the Cupolas in the Old Foundry

modern foundry engineering. Ample light and ventilation are assured by the extensive windows. Comfort and convenience of the workman have been anticipated on a second floor fully equipped with wash and locker rooms. Part of this section of the building has been set apart as a dining room. Under the present management the workmen are paid on a piece work basis, therefore it is to their own interest to use their time to the best advantage. As a result many of the minor disciplinary measures prevalent in the majority of foundries are not observed here. The men smoke when and where they please and they eat in the same free and easy manner.

Has Three Divisions

As at present constituted, the working floor of the foundry is laid out in three main divisions extending north and south. Approximately one-fourth of the west bay is walled in to serve as a store room for supplies and also as a shelter for the equipment connected with the cupola. The remainder of the west bay, divided into three sections, is devoted to making, drying and assembling the cores that are used extensively on die block castings.

The three large ovens, built by the company and equipped with fuel economizers supplied by the Mayor Fuel Saving Furnace Co., Cleveland, occupy the center of the space and are equipped with doors at both ends. The cores are made in the space between the ovens and the south end of the bay, loaded on cars, dried in the ovens and removed from the cars after they emerge at the north end of the ovens.

Fig. 3—The Electric Furnace, Newly Erected

Fig. 4—Tapping the Electric Furnace

Molds are made over or in approximately two-thirds of the floor space, that is in two bays, 30 and 40 feet wide respectively. The side bay is spanned by one 10-ton crane and the center bay is served by two similar cranes made by the Whiting Corp., Harvey, Ill. No hard and fast rule is observed, but in a general way castings weighing between 1000 and 2000 pounds are made on the side bay. All those above that weight are molded in the second or center bay.

Shape of the casting is a more important factor than weight in determining where the mold is to be made. Concrete pits in the center bay are equipped in a special manner to facilitate the molding of patterns up to 5 feet in depth. All the molds on the side floor are built up from bottom plates resting on the floor. The channel steel flasks in use are 12 inches in depth and the mold rarely is built to a height exceeding three of these sections. If a deeper flask is needed, the pattern is taken to the center bay and bedded in one of the pits in the floor. Exceptions are made occasionally under special conditions but usually the system works out automatically, since the largest and heaviest castings usually are the deepest.

Although a jobbing shop in the sense that orders run to single castings rather than duplicate castings in great numbers, still the usual jobbing shop methods have been discarded to a considerable extent. Many of the short cut methods developed in the production foundries have been incorporated here and as a result the tempo is much faster than otherwise it might be. The molders, those with former training and those developed in the plant, have been taught to distinguish between the essential and nonessential features in a casting. They waste no time in imparting a piano finish or in carefully slicking that part of a mold which forms the face of a casting that later will be bolted to a foundation or buried in a concrete casing.

Use Dry Sand Cores

Many of the hazards incident to the formation of large molds containing pockets, flanges and other peculiar shaped bodies of sand, have been eliminated by substituting dry sand cores for the usual green sand. In some instances the cores are fitted against the pattern and then the remainder of the space in the flask or pit is filled with rammed sand. In other instances the patterns are fitted with suitable coreprints and the cores are placed in position after the patern is withdrawn from the mold. The former method is the more extensively employed. It presents many advantages outside the primary advantage of presenting a solid body of sand that will insure the proper shape to the part of the casting. The dry sand core is an insurance against cuts, scabs and swells. It will produce a clean surface on the part of the casting with which it comes in contact. Castings that ordinarily

Fig. 5—Tapping the Cupola in the New Foundry

would require the services of the most highly skilled molders easily are made by this method by men who require only a little preliminary training.

The method was developed primarily to insure a face, perfect in skin and contour, on the faces of dies used in stamping thin sheet steel in the automotive industry. Naturally the working face of the die block forms the bottom of the mold. Where the sand is not rammed uniformly and to the proper density on molds of this kind it will yield under the weight of the iron. The resulting casting will present a working face that differs more or less from the face of the pattern. Where the sand is rammed too hard, it will cut and scab and the result in either case is a casting that either must be scrapped or, subjected to a great deal of hand tooling to bring it to proper shape.

Fig. 7—The Various Core Prints Are Numbered and the Cores Are Marked to Correspond

Fig. 6—Materials for the Charge Are Stocked on the Steel Charging Floor

A dry sand core to form the entire working face of the die block solved this problem and converted a former nuisance into a highly desirable job from the foundryman's viewpoint. Several steps in the production of die block castings by this method are shown in the accompanying illustrations.

Cores are made from a fine grade of lake sand. It is bonded with oil and prepared in a revolving paddle device made by the Standard Sand & Machine Co., Cleveland. A definite quantity of oil is pumped into a container mounted above the mixing trough.

Sufficient water also is added to make the sand workable. The required quantity of sand then is shoveled into the trough and a valve is released on the oil and water which then flow in combination through a horizontal pipe pierced with ¼-inch holes. This device distributes the oil and water through the sand while it is revolving under the impact of the staggered paddles mounted on a shaft located at a central point.

The easiest way to make one of these die block face cores would be to mount the block on a board or plate, place a flask or frame around it, fill the frame with rammed sand, bed a bottom plate in place, clamp the entire assembly together and roll it over. Then the pattern also the frame or flask could be removed, thus leaving the core face side up resting on the plate.

Want Absolute Accuracy

Objection to this method is based on the fact that the sand is bound to sag to a certain extent during the rolling over process and as a result, the face of the dried core will not present an accurate impression of the face of the pattern.

To insure perfect accuracy in this respect the cores in this shop are built up against the face of the patern and are *not* rolled over. The core plates are cast iron, approximately 1½ inches thick and strongly ribbed on the under side. They hold their shape under all conditions and do not warp or twist.

Usually the face of the pattern presents a decidedly uneven surface.

Fig. 8—One of the Slings Employed With a Beam to Handle the Loaded Core Plates Is Shown in the Center of the Illustration

Fig. 9—Typical Molds for Large Die Castings in Which the Greater Part of the Mold Is Formed With Dry Sand Cores

To save sand, impart strength and hasten the drying period, the thickness of sand is held to 3 or 4 inches. The space between the plate and the sand thickness is filled with bricks. At the lowest point the thickness of sand alone separates the pattern from the plate. At the highest point the sand and brickwork may extend to a height of 2 feet. The cores are handled with a beam and a pair of slings of special design. Each rigid sling forms the two sides of an isoceles triangle with the lower ends flattened and turned into a pair of hooks that grip the bottom edge of the plate.

After the pattern is removed the plate and core are placed on one of the steel beam cars. At the close of the day the loaded car is pushed into one of the ovens. The following morning it is pulled out of the oven on the opposite side and the faces of the cores are covered with blacking. Each core with its supporting plate and brick reinforcement then is lifted from the car and taken to its appointed place on the molding floor. The empty car is picked up by the crane, lifted over the oven and lowered to the track in the position it occupied on the preceding morning.

A transfer truck traveling on an industrial track carries the core assembly into the center bay of the foundry, where it is picked up by one of the cranes and lowered into one of the prepared pits. Here it is adjusted in a manner to support the pattern that will bring the top flat surface level and flush with the floor. In some instances it is necessary and in others simply expedient, to allow the pattern to project above the floor level and surround it with a flask section. Space surrounding core and pattern is filled with rammed sand. A cope is rammed and removed; after which the pattern is taken out of the mold. Subsequent steps in finishing the mold present no unusual features, except that perhaps the risers are cut a little larger than usual.

The pits in the center bay are walled and floored with concrete and provided with an adequate drainage system to insure a perfectly dry bottom at all times. The pits are 10 feet wide and may be divided off into units 4, 8 or 12 feet by suitable bulkheads with the outer ends anchored in slots in the concrete walls. A clamshell bucket suspended from one of the cranes is employed to dig the sand out of the pits. Rings anchored in the walls at suitable intervals serve to hold the bolts by which the copes are held down during the casting period.

Fig. 10—Cars Are Loaded and Run Into the Ovens From This End. After the Cores Are Dried the Cars Are Pulled Out Through the Opposite End

Toledo Shop Celebrates Opening Addition

Industrial Steel Casting Co., Toledo, O., held open house to a large number of friends from the city and outside points on Aug. 20 to mark the formal opening of an extensive addition to the plant. Formal invitation to this function was presented in the form of a cardboard folder containing a series of views of the plant. The name of each guest receiving an invitation was hand lettered on the outside lower right corner of the folder. A buffet lunch was served in the second story rooms of the new office building. Officers of the company whose plant was described in the Aug. 1 issue of THE FOUNDRY include: J. L. Tillman Sr., president; W. E. White, vice president; J. L. Tillman Jr., vice president; R. J. Tillman, secretary; L. J. Tillman, treasurer.

Stove Makers Unite

Manufacturing, delivery and storage facilities of the Buck Stove & Range Co. and the Bridge & Beach Mfg. Co., St. Louis, two of the oldest stove manufacturing concerns in the country, are to be combined at the latter's plant, 4204 Union boulevard. The plant of the Buck Stove & Range Co., erected in 1846, will be sold. Both companies, however, will retain their identities, merely combining forces to reduce duplication in overhead costs and obtain lower manufacturing costs. The Buck executive offices will be moved to the Bridge & Beach plant. Change in manufacturing policy will entail only a negligible reduction in personnel. The Bridge & Beach plant was selected because it is thoroughly modern, being erected in 1926. It covers three blocks and cost upward of $2,000,000. The combined capital of the two companies is $2,500,000.

Alloy Additions *Affect* Corrosion of Cast Iron

By Paul Koetzschke

IMMENSE waste, which world industry continually suffers through chemical or electrochemical destruction of metals and metal alloys, has brought about the urgent need of clarifying through exact scientific research, corrosion phenomena and reactions to such an extent that these losses may be diminished successfully.

The first investigations in this direction were carried out in Germany by E. Heyn and O. Bauer, *Mitteilungen Materialpruefung*, 1908 and 1910, who, stimulated by the rivalry between the different varities of iron, sought to solve the question, as to whether cast iron, wrought iron or cast steel showed a more favorable reaction to corrosive influences. In this examination difficulty was encountered in correctly determining the influence of uncombined carbon, that is graphite, in cast iron.

According to the electrochemical theory of corrosion, which today finds the greatest acceptance, the more rapid disintegration of cast iron in acids as compared with purer irons, is based on the occurrence of local currents between ferrite or pearlite and graphite. The latter according to the investigations of Bauer and Vogel, *Mitteilungen Materialpruefung*, 1918, is electropositive toward the metal. Recently a special significance was attributed to the over-voltage value which hydrogen bears to graphite as the cathode.

Researches made by different investigators to ascertain this over-voltage value led to so many contradictory conclusions, that the role played by graphite could not be determined clearly. The influence of graphite is of less importance on the rust reaction than is its influence on the disintegration of cast iron in acids. For that reason in numerous comparative investigations which have been made, no essential differences could be established between graphite-free iron and iron with a graphite content.

Silicon is the most important of the elements occurring in cast iron. Therefore, it is not surprising that the numerous investigations had as their objective, the explanation of its influence on corrosion behavior. In England and in the United States it was known at a comparatively early period, that an addition of over 12 per cent silicon to gray iron, produced an acid-corrosion resisting alloy. However, it was not until 1913 that J. N. Friend and C. W. Marshall, *Journal*, Iron and Steel institute, 1913, and later Schenck, *Bulletin*, British Cast Iron Research association, 1924, Girard, *Revue Metallurgie*, 1926, and Haase, *Dissertation*, Clausthal, 1927, tried to ascertain the influence of the usual silicon content in cast iron on corrosion and rusting. Whereas, the first mentioned investigators could not determine any perceptible influence on the acid corrosion nor on rusting with a silicon content between 1.2 to 2.3 per cent, the attack in acids according to Haase increases from 3 up to 6 per cent of silicon and again drops off from that point to a lower value.

Correlates Work

ALTHOUGH a number of researches have been performed on the resistance of ordinary and alloyed cast iron, to corrosion and rusting, many of the results are not in agreement, particularly on the effect of graphite and silicon content, and of such alloying elements as nickel and chromium. Therefore, the author carried out a series of investigations to determine the correctness of previous work and correlate the results. This article is the first of two which constitute a thesis submitted by Dr. Koetzschke for a degree of doctor of engineering at the Tecnischen Hochschule, Aachen, Germany.

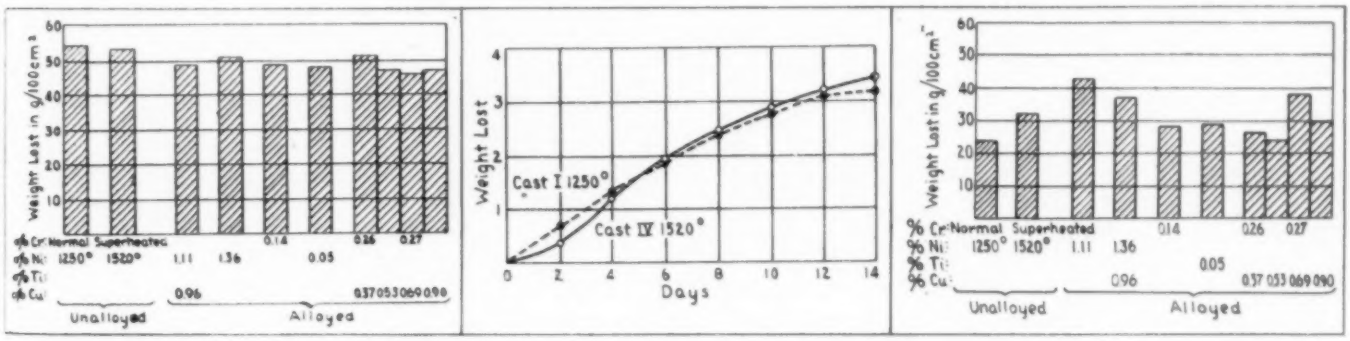


FIG. 1—CORROSION OF VARIOUS KINDS OF IRON IN HYDROCHLORIC ACID. DURATION OF TEST 6 DAYS. FIG. 2—LOSS IN WEIGHT OF TWO SPECIMENS IN HYDROCHLORIC ACID. ONE CAST AT 1250 DEGREES CENT., AND THE OTHER AT 1520 DEGREES. FIG. 3—SIX-DAY CORROSION TEST ON IRONS IN ACETIC ACID

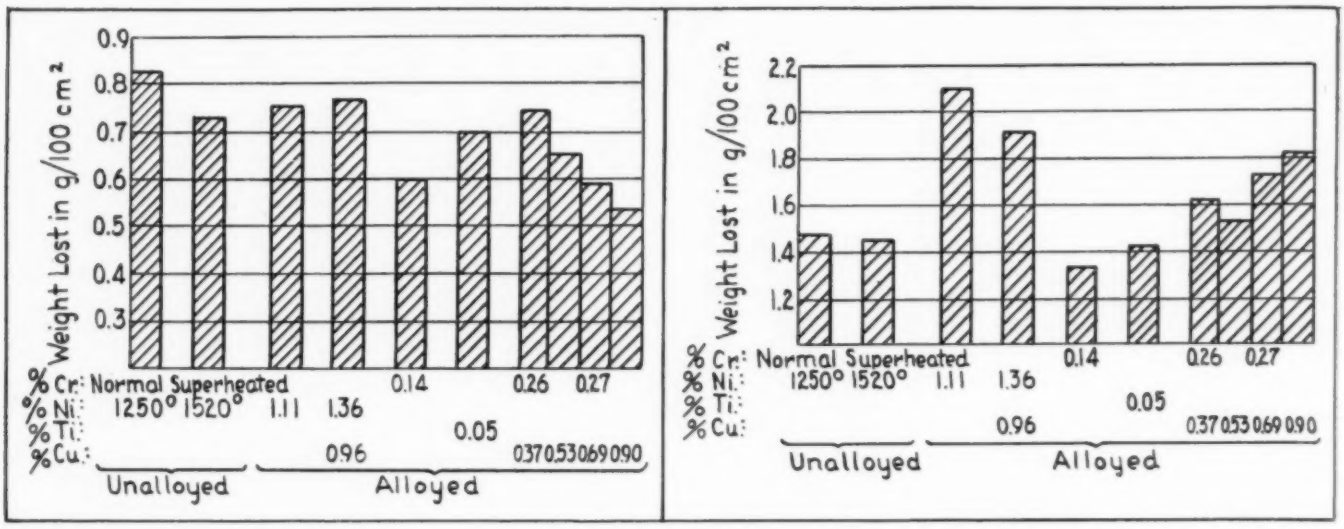


FIG. 4—RUSTING TESTS IN COMMON SALT SOLUTION. DURATION OF TEST 22 DAYS. FIG. 5—FOURTEEN-DAY TEST IN AMMONIUM SULPHATE SOLUTION

On the other hand, according to later investigations by Denecke, *Die Giesserei*, 1928, corrosion in acids begins to drop with an increase of silicon content above 3.5 per cent.

Little has been learned of corrosion behavior from researches on the influence of such elements as nickel, chromium; nickel and chromium together, as well as copper which in recent years originally were alloyed to improve the mechanical properties. The favorable influence of a slight addition of nickel merely could be observed by several investigators including Haase, while Everest, Turner and Hanson, *Journal*, Iron and Steel institute, 1927, (Compare *Stahl und Eisen*, 1928) found a stronger attack on cast iron alloyed with nickel as compared to an unalloyed cast iron. The trend of the investigations which follow was influenced by the scarcity or total lack of available data on the influence of the physical structure and amount of graphite, silicon, nickel and chromium, separately and in combination, and copper.

In extended preliminary investigations, the first were made on the influence of the physical structure of graphite changed through suitable melting operations (superheating) and the influence of slight additions of nickel and copper on the corrosion in acids and the rusting in salt water solutions.

Gives Analyses

Analyses of the specimens investigated are compiled in Table I. The alloyed ones were melted in crucible furnaces at a temperature of 1300 Cent. (2372 degrees Fahr.) and the unalloyed were melted in graphite crucibles at 1250 and 1520 Cent. (2282 and 2768 degrees Fahr.) respectively and cast in dry sand molds into rods 0.39-inch in diameter and 11.8 inches long, from which cylindrical test samples 0.315-inch, 0.47-inch, and 0.35-inch in diameter respectively were turned up of the unalloyed melts. A small conical extension served for the purpose of fastening the horse-hair threads, by which the test samples were hung vertically in the fluid after being cleaned with alcohol.

Conditions governing the tests and the results of the corrosion tests in 1/5 normal hydrochloric acid, 1/5 normal acetic acid, 1/10 normal sodium chloride and 1/10 normal ammonium sulphate solution are shown in Figs. 1 to 5. In this connection it should be noted, that only the alloyed as well as the unalloyed melts could be compared relatively with each other on account of the difference in area of their exposed surfaces.

Influence of the graphite structure, obtained through different degrees of superheating in melting, either in acid corrosion or in rusting in salt water solutions is yet to be determined.

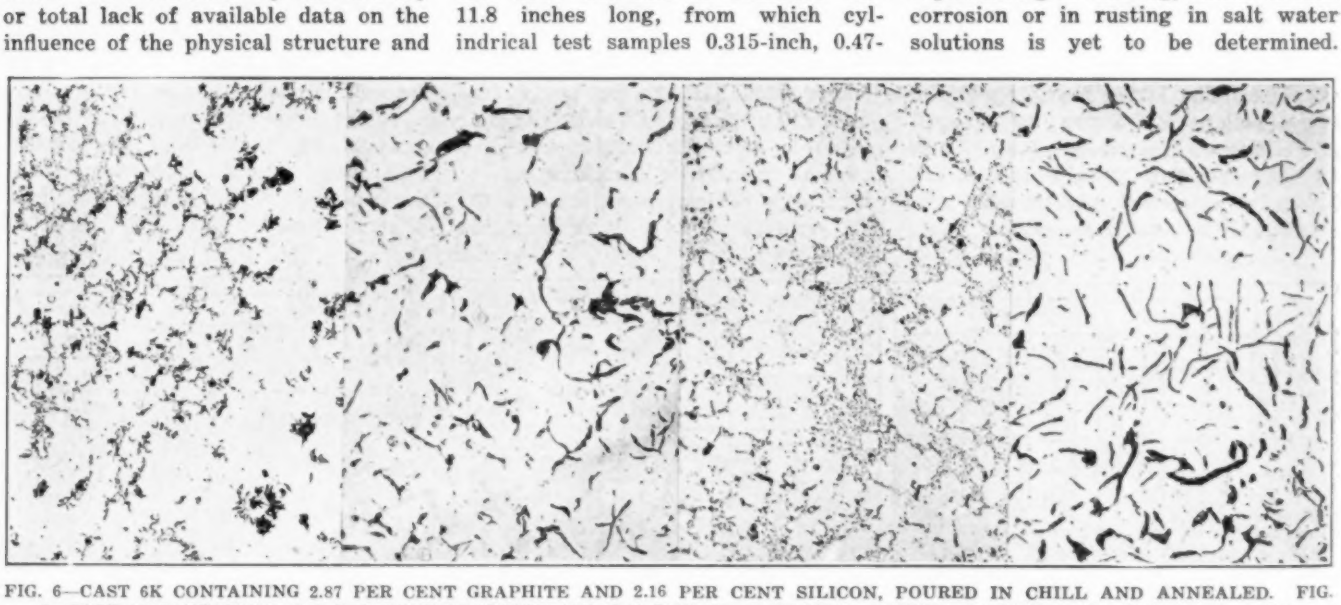


FIG. 6—CAST 6K CONTAINING 2.87 PER CENT GRAPHITE AND 2.16 PER CENT SILICON, POURED IN CHILL AND ANNEALED. FIG. 7—CAST 6S CONTAINING 2.89 PER CENT GRAPHITE AND 2.16 PER CENT SILICON, POURED IN SAND AND ANNEALED. FIG. 8—CAST 7K CONTAINING 2.68 PER CENT GRAPHITE AND 3.46 PER CENT SILICON, POURED IN CHILL AND ANNEALED. FIG. 9—CAST 7S CONTAINING 2.65 PER CENT GRAPHITE AND 3.46 PER CENT SILICON, POURED IN SAND AND ANNEALED

Similarly the alloying elements bring about no change in the attack of hydrochloric acid, while in acetic acid a higher silicon content admixture materially increase the corrosion. In the rust investigations a strong protective action is indicated with an increasing copper content in sodium chloride solutions and the unfavorable influence of a nickel addition in an ammonium sulphate solution.

For the main tests which readily confirm the results of the preliminary tests, new melts running as high as 17.6 pounds were melted in graphite crucibles and crucible furnaces and cast into test specimens 11.8 inches long and 0.787-inch in diameter. Melting temperature in all cases lay between 1320 and 1370 degrees Cent. (2408 and 2498 degrees Fahr.) and were measured with a calibrated pyrometer. The pouring temperature averaged 1250 degrees Cent. (2272 degrees Fahr.). Analyses as well as cooling conditions and annealing operations where necessary, are compiled in Table II. The cylindrical test specimens were 0.55-inch in diameter, 0.59-inch in height and had an effective surface of 1.5 square inches. The pieces also were provided with small conical extensions for fastening the horse-hair thread and were polished brightly with No. 0 emery cloth.

Gives Testing Procedure

Before the corrosion test the samples were washed carefully several times in alcohol and weighed. The loss in weight, after a certain period of corrosion, served as a measure of the amount of corrosion referred to a 100 square centimeter (15.5-square inch) area. The period of corrosion was of varying duration, depending on the kind of corrosive medium used. For a better removal of the rust, the test pieces were treated with zinc dust and caustic potash solution, carefully washed, rinsed in alcohol, dried and weighed. Corroding solutions as follows were used:

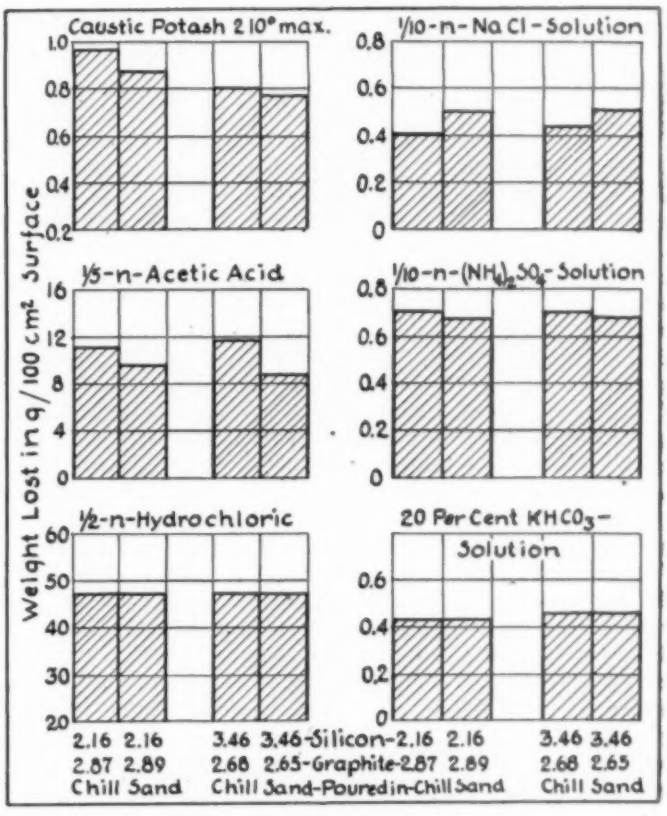
1/2 normal hydrochloric acid
1/5 normal acetic acid
25 per cent caustic potash solution and melted caustic potash
1/10 normal sodium chloride or common salt
1/10 normal ammonium sulphate solution
20 per cent calcium bicarbonate solution

All investigations with the exception of the corrosion tests in strong lye and the test of the copper-containing samples for weather resisting qualities, for which special conditions were chosen, were performed in glass beakers of the same size. The liquid volume at the start in every case amounted to 100 cubic centimeters; a replenishment was made only in the case of the acids, to maintain continually an excess of hydrogen ions and to eliminate rusting through oxygen from the air diffusing into the liquid.

Only one test piece was placed in each beaker and similar means of suspension made up of horse-hair were used to hang them at equal distances from the top surface of the corroding solution. This is of special importance in rust investigations, in which the oxygen in the surrounding air diffuses into the solution. The temperature of the surrounding air was always 20° ± 1 degree Cent. (68 ± 1.8 degrees Fahr.). In all tests at least three, often four parallel tests were made, so that the final results show the average of each of the tests.

For the corrosion tests in the caustic potash the cylindrical bases of the specimens had an 0.06-inch diameter hole drilled in them to a depth of 0.14-inch and were placed on an 0.04-inch bent nickel wire so that they hung in a vertical position in the solution. No unfavorable influence of the nickel wire could be observed as a result of the difference of potential at the point of contact between the nickel wire and the test pieces. The contact surface between the nickel wire and the test piece was small in comparison with the total surface of the test piece, so that this method of suspension appeared unobjectionable.

In these tests three or four test pieces of the same kind of cast and charge, always were immersed simultaneously in the solution without their touching each other. The tests consisted of several evaporations of an originally 25 per cent caustic potash solution, which was replenished to increase the concentration with 300 and 250 cubic centimeters of solution after 5½ to 8 hours test, and cooling. In this way the usual practice of evaporation of strong lyes in iron kettles was imitated closely or duplicated. In the test in melted caustic potash, 2.2 pounds of solid 80 per cent caustic potash was melted and the test piece was corroded for 8 hours at a constant temperature of 450 degrees Cent. (822 degrees Fahr.).



Figs. 10 and 11—Corrosion Tests of Cast Irons with Varying Graphite Structures in Acid and Alkaline Solutions of Different Concentrations

For the weathering tests of copper bearing melts, use was made of test pieces 0.945-inch in diameter, 0.984-inch in height with an active surface of 4.25 square inches. These were turned from rods 23.62 inches long and 1.18 inches in diameter.

Charges No. 6 and 7, served to determine the influence of the structure of the graphite, which were poured half in sand and half in chill molds for the purpose of obtaining the greatest possible difference. To eliminate the disturbing effect of a varying matrix, all the test pieces were annealed until they attained an entirely ferritic structure. Figs. 6 to 9 show the nature of the graphite structure after annealing, while the results of the corrosion tests are shown schematically in Figs. 10 and

Table I

Chemical Analyses of the Preliminary Investigation Melts

Melt No.	T.C.	C.C.	Gr.	Gr. in % of T.C.	Si	Mu	P	S	Ni	Cr	Ti	Cu
I Normal	3.63	0.70	2.93	80.70	1.80	0.70	0.286	0.017	.....	.....	.....	.....
IV Superheated	3.78	0.70	3.08	81.50	2.30	0.57	0.447	0.045	.....	.....	.....	.....
G	3.58	0.46	3.12	87.15	2.10	0.71	0.381	0.023	1.12	.....	.....	.....
H	3.56	0.68	2.88	80.90	2.15	0.71	0.396	0.030	1.36	.....	.....	0.96
A	3.66	0.80	2.86	78.20	2.44	0.75	0.300	0.018	.....	0.144	.....	.....
D	3.70	0.92	2.78	75.20	2.24	0.72	0.230	0.026	.....	.....	0.051	.....
C	3.60	0.73	2.87	79.70	2.38	0.75	0.257	0.028	.....	0.265	.....	0.37
B	3.55	0.60	2.95	83.10	2.45	0.73	0.321	0.013	.....	.....	.....	0.53
F	3.50	0.79	2.71	77.40	2.34	0.70	0.504	0.018	.....	0.273	.....	0.696
E	3.66	0.60	3.06	83.70	2.14	0.71	0.399	0.019	.....	.....	.....	0.90

11. In the hydrochloric acid test no influence due to the form of the graphite structure is noticeable, while in the substantially weaker acetic acids, the test pieces poured in sand with coarse-flaked graphite oddly enough show a somewhat better behavior than the specimens with fine graphite poured in the chill molds. In the corrosion test with 25 per cent potash lye the test pieces poured in sand have experienced likewise a slighter attack.

These results are contrary to the views expressed by Bauer, *Nachschrift*, Verein deutscher Ingenieure, 1927. Bauer takes it for granted, that a coarse-flaked graphite through a more intensive rearrangement of the grain structure of the casting, implies a stronger atack in acids than a fine graphite formation. According to the electrochemical theory it also could be assumed however, that the number of local elements present is a deciding factor in the intensity of the attack. In this case the cast iron with the fine graphite would suffer more from corrosion. However, our investigations show, that the graphite form structure does not produce any marked influence at all, so that the assumption that the number and size of the graphite particles per unit surface do not play a leading role in corrosion by acids and lyes appears justified.

Rather the intensity of attack primarily is determined by the chemical composition, particularly by the silicon content, by the general structure and to a slight extent also by the amount of graphite present. However, since in our investigations the chemical composition as well as the absolute amounts of graphite are always alike and through annealing the structure of all test pieces is made homogeneous, the corrosion results also should show an agreement in the intensity of the attack in spite of the varying graphite structure. The slight differences which do occur lie throughout within the allowable limits of error in corrosion investigations and are therefore no argument against this view. These results are more noteworthy, since recently, according to W. Roth, *Zeitschrift augen Chemie*, 1928, temper carbon formed under high pressure has been considered a special modification of carbon differing from graphite in specific gravity and energy content, which really should result also in a difference of potential.

Rusting tests in 1/10 normal common salt, 1/10 normal ammonium sulphate and 20 per cent potassium bicarbonate solutions show satisfactorily that the graphite structure has no influence on the behavior in salt water solutions. The results of the preliminary investigations in which the graphite structure was changed through superheating thereby are confirmed. They cannot be reconciled in this case either, with the views expressed by Bauer, as according to his theory the coarse graphite flakes due to the capillary action draw moisture into the iron and thereby accelerate the rusting process. However, it is not evident, why this property should not be just as inherent in the fine graphite particles, which certainly thread the structure with a much more closely interlaced network, through which moisture can seep in.

(*Concluded on Page* 839)

Table II

Chemical Analyses of the Principal Research Melts

Melt No.	T.C.	C.C.	Gr.	Gr. in % T.C.	Si	Mn	P	S	Ni	Cr	Cooling Conditions	Fracture	Annealed at
6K	2.94	0.07	2.87	97.60	2.16	0.63	0.28	0.042	....	....	Chilled	Mottled	820° for 5 hr.
6S	2.92	0.03	2.89	99.00					....	....	Dry Sand Mold	Gray	820° for 5 hr.
7K	2.71	0.03	2.68	99.00	3.46	0.58	0.27	0.049	....	....	Chilled	Gray	820° for 3 hr.
7S	2.73	0.08	2.65	97.20					....	....	Dry Sand Mold	Gray	820° for 3 hr.
1	2.88	0.36	2.52	87.60	3.19	0.74	0.42	0.033	....	....	Green Sand Mold	Gray	.. .. ..
2	2.85	0.52	2.33	81.80	2.05	0.69	0.42	0.026	....	....	Dry Sand Mold	Gray	.. .. ..
2a	2.85	0.09	2.76	96.90									
3	2.78	0.83	1.95	70.20	1.54	0.71	0.41	0.031	....	....	Mold at 200°	Gray	.. .. ..
3a	2.63	0.03	2.60	98.90									
4	2.52	1.32	1.20	47.60	0.96	0.52	0.24	0.078	....	..	Mold at 500°	White	800° for 20 hr. 930° for 8 hr.
5	2.55	0.50	2.05	80.40	0.67	0.33	0.10	0.083	....	....	Mold at 600°	White	800° for 20 hr. 930° for 8 hr.
11	2.98	0.54	2.44	81.80	2.09	0.79	0.37	0.028	1.05	....	Dry Sand Mold	Gray	.. .. ..
12	2.86	0.64	2.22	77.70	1.86	0.72	0.37	0.024	3.17	....	Dry Sand Mold	Gray	.. .. ..
13	2.73	0.43	2.30	84.30	1.74	0.62	0.37	0.030	5.70	....	Dry Sand Mold	Gray	950° for ½ hr.
21	2.85	0.66	2.19	76.90	1.73	0.62	0.38	0.032	....	0.54	Dry Sand Mold	Gray	.. .. ..
22	3.06	2.09	0.97	31.70	2.01	0.69	0.34	0.025	....	1.12	Dry Sand Mold	White	950° for 1 hr.
25	2.65	0.91	1.74	65.70	1.73	0.70	0.32	0.026	2.65	0.61	Dry Sand Mold	Gray	.. .. ..

MELTS *Various Alloys* in Gas Fired *Furnaces*

By J. B. Nealey

Fig. 1—Pouring Molds Located on the Special Skids

THE foundry, as an integral part of the large manufacturing plant, is called upon to improve its methods, better its products, reduce operating costs and to otherwise keep up with the progressive modernization of the age. The foundry of the Liquid Carbonic Corp., Chicago., is an excellent example of this trend. One of the recent improvements at that plant consists in a change in fuel policy and converting its brass melting furnaces from coal to city gas.

The Liquid Carbonic Corp. shipped the first carbonic gas in 1889, introduced the first carbonator in 1894, added a line of extracts in 1896, started marketing the liquid low pressure bottle filling units in 1914, produced the liquid rotary crowner in 1922, put out a liquid bottle cooler in 1924, etc., etc. Today it is the greatest factor in the carbonated beverage industry, operates 18 modern carbonic gas plants, and supplies a large percentage of the total output used. Its carbonating machinery will be found in the majority of the bottling plants throughout the country.

All of this involves a large amount of diversified manufacturing for the company makes all of its machines and products and is self contained from raw material to finished product. The

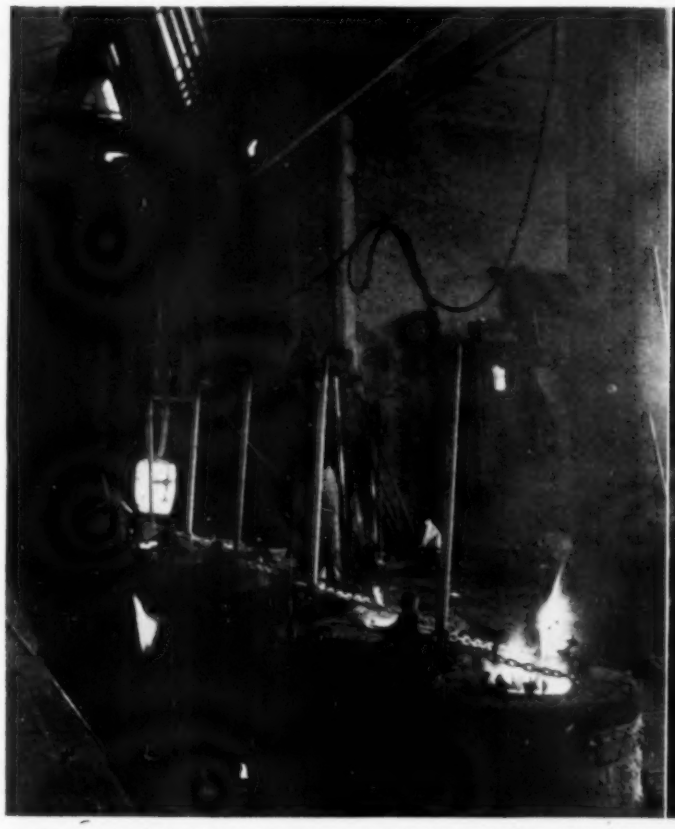


FIG. 2—A GROUP OF GAS-FIRED, CRUCIBLE, MELTING FURNACES FIG. 3—LIFTING A CRUCIBLE OF MOLTEN METAL FROM THE GAS FURNACES

modern plant has a floor space of 500,000 square feet.

As many parts of the various lines of machines and products are brass and alloy castings, the foundry is called upon to produce a wide diversity of castings. A better way to gage the range of work in the foundry department is through the number of patterns which total more than 8000 and practically all of which are active. The bottle filling machine alone consists of 2000 parts more than half of which are cast in the foundry.

Uses Gas

Sometime ago this company replaced 15 of its 30 coal-fired brass furnaces with six gas-fired furnaces equipped with recuperators. The gas furnaces now handle the bulk of their production, the remaining coal furnaces being used only for special alloys. The company melts yellow brass, red brass, phosphor bronze, hard brass and aluminum.

The foundry is located on the fourth floor of the main factory building and has a capacity for 100 tons per month. It occupies a space of 80 x 170 feet and is served with an overhead monorail system with three-ton electric hoists. The molding machines are arranged along one side of the room, the crucibles on the other and the pouring floor between.

When the flasks are completed they are set on stands, made of metal rails, to hold them in the correct position and at a height from the floor which is convenient for pouring, in this case about 18 inches. The flasks are tilted at an angle to assure an even flow of metal. Another rail just above, holds cast iron weights which are tipped onto the flasks and other weights are piled close by if more are needed. The amount of weight used is regulated by the type of castings being poured. The crucibles are lifted out of the furnaces by air hoists and conveyed to the pouring floor and the metal is poured directly into the flasks.

The core making room is 20 x 35 feet, and is equipped with core machines and drawer-type ovens. The ovens are 10 feet wide, 6 feet high and 4 feet deep and are fired with gas. The sandblasting room contains tumblers. sprue and gate cutters, grinders, etc.

Makes Large Castings

Some large and intricate castings are made in this plant, one in particular being the filling tank which is annular in shape, 6 feet in diameter, 112 inches deep, 10 inches between walls and weighs 600 pounds. The wall sections are between $\frac{1}{8}$ and $\frac{3}{8}$ inch in thickness. The bottom has forty 3-inch openings for the drilling valves and 3-inch lugs on 10-inch centers, both inside and out for locking on the cover. In all there are seventy-three cores used and the whole requires a special steel flask.

The melt from three No. 80 crucibles is poured into this flask simultaneously through three openings. The cope and drag are skin dried slightly with gas torches just prior to pouring to minimize the forming of gases.

As previously stated most of the metal is melted in six gas furnaces. Usually all six furnaces are in operation nine hours a day and No. 80 crucibles, holding 240 pounds of metal are used. With the gas furnaces the first heat in the morning takes about 1 hour and 50 minutes, subsequent heats requiring only 45 to 55 minutes. While normally four heats per furnace per day are produced, six can be secured without difficulty.

A typical month was chosen and data obtained on production and production costs. The output for this month from the six gas furnaces was 120,614 pounds and the cost for gas totaled only $446.32. The gas consumption was 658,698 cubic feet or 5445 cubic feet per 1000 pounds of metal poured. The total operating cost for the month, including all items except supervision and general overhead, amounted to $800.50 or $6.64 per 1000 pounds of metal.

Advance Hyatt Executive

H. O. K. Meister, formerly general sales manager of the Hyatt Roller Bearing Co., Newark, N. J., has been appointed assistant general manager of that company. Mr. Meister has served as manager of the Western division in Chicago and as assistant general sales manager. In 1925, he was appointed general sales manager.

FIG. 4—MOLDS ARE MADE ALONG THE WALL WHERE PLENTY OF LIGHT IS PROVIDED FOR THE MOLDERS

Continuous Operation Cuts Production Costs

Development of Conveyors Traced Since First Installed Nearly 40 Years Ago—Special Conditions Met by Adaptation of Design—Benefits Due to Continuous Operation Enumerated

By R. J. Heisserman

SUCCESSFUL installation and operation of power mold conveyors in a Pennsylvania foundry more than 38 years ago, was the forerunner of mass production by mechanical means.

This is quite a broad statement, when we consider the benefits now being derived from mass production, but the same general principles of specialized work for each operator, then used the two *T* rail tracks for supproduction methods of today.

The general design of this early forerunner of the present day mold conveyors consisted of successive carriages about 2 feet above the floor, each having rollers, and traveling on bulb rails. The carriages were attached to a chain, which formed the propelling medium, and the molding operations were carried out in much the same manner as at present.

Some Not Successful

While this continuous molding unit was producing castings at one-half cent less per pound, which was quite a saving at that time, other types of conveyors, not quite so successful, were being installed.

One of these, similar to the "Old Mill" in amusement parks, consisted of a series of boats floating in a canal. Propellers were installed at various points around the bottom of the canal to give motion to the water, which in turn moved the boats. The molds were placed on the boats for pouring, cooling, and conveying to the shakeout station. The main idea back of this equipment, or experiment, was smooth handling of the molds, as it was then thought that a mechanical conveyor would break the molds in transit. Many difficulties were experienced in trying to make this carrier work. The main reason for failure was that hot metal dropped into the water, either from the ladle or from runouts.

Sometime later, the pendulum or trolley type mold conveyor was conceived in the Middle West, and this type still is used with great success in the plant where it originated, as well as in automobile and radiator foundries. This machine consists of long hangars, made of pipes or structural steel, to the bottom of which are attached trays for carrying the molds. Flanged rollers are attached to the hangars at their upper ends, which in turn travel on a flat steel track. A chain is attached adjacent to the rollers to provide motion to the hangars and to keep them properly spaced.

Describes Equipment

MANY types of equipment have contributed to the speeding up of production in the foundries. Mold handling has become one of the major factors. In this article the author classified various types of handling equipment and shows how each may be used to advantage. The author of this article, which is abstracted from a paper presented at the Chicago convention of the American Foundrymen's association, is connected with the Link-Belt Co., Chicago.

Although an electric motor drive, with the necessary gear reductions and end sprockets, is used on most machines of this type, some are propelled by a wire cable and an air cylinder. The advantage of this machine was, that the rollers, track, and chain, together with all driving machinery, were overhead and safe from falling sand or hot metal. This resulted in smooth travel and minimum wear, but required rather expensive construction.

As time went on, a chain was developed that would stand the wear and tear of sand and hot metal and which, therefore, need not be placed overhead. This did away with the costly overhead steelwork, and also made it possible to locate the motors and driving machinery in pits or on the floor.

Various designs of this type machine have been made, all of which used the two *T* rail tracks for supporting the mold tray. The chain on the earlier type conveyors was carried on a separate pair of rails, and was equipped with dogs or attachments for pushing the trays along the tracks. On the later machines, the chain is supported by the trays. It is attached directly to them, eliminating the extra rails. In most cases this tray slides directly on the rails, although a few have been made in which the trays are fitted with rollers. The smoothest travel is obtained with the sliding trays, as these keep the tracks cleared. Rollers on the truck trays tend to ride over any obstructions of metal or sand, causing jolts, or will slide, due to shot on the rails, resulting in flat spots on the rollers.

Handles Small Molds

This sliding conveyor is used extensively for the handling of snap flasks, and the smaller steel and iron flask molds, although quite a few are handling molds weighing approximately 300 pounds.

To eliminate a crane or hoist handling from the molding station to the mold conveyor for these heavier molds, the cope and drag are built on a stationary piece of gravity conveyor placed at right angles to the power driven mold unit.

The trays of the power mold conveyor are then made up of gravity rolls, which permit rolling the molds upon the conveyor tray from the stationary gravity conveyor.

Recently a power mold conveyor has been developed for handling molds of 500 to 600 pounds over a great distance with a low power consumption. This conveyor is liberally equipped with high grade tapered roller bear-

ings. The tracks of this conveyor are attached to the under side of the trays, making it impossible for metal or sand to fall on them. Besides being inverted, they are always under the tray. The chain likewise is protected in its position under the inside edge of the tray. The inverted tracks ride on large diameter rollers, having pressure lubricating attachments for the roller bearings on which they revolve. The overlapping trays completely cover the rollers, making a continuous moving platform, and the rollers are thus protected from the sand and iron.

Still another type consists of trays, or pallets, fitted with swivel casters and traveling through a rectangular path. Propulsion is provided by air cylinders mounted at the corners and giving motion to each horizontal line of trays, the corner turn being accomplished by the nature of the joint between adjacent trays.

The conveyors enumerated thus far are of the continuous power type used in large production foundries, and foundries where it is possible to obtain a continuous flow of metal.

Other types of power driven mold conveyors might be mentioned, but in a great many cases they represent the same general design, with variations to suit the individual case. Special conditions may dictate special forms or applications, suitable only to one or two installations. However, the underlying principle of general design is applicable to all.

Semicontinuous Foundries

In the semicontinuous pouring foundries, or in foundries where pouring-off is done once a day, we find the following methods of mold handling:

Manual: Where the molder carries out the molds he makes, or has a helper to do this work.

Crane, Jib or Hoist: Operated manually, electrically or by air. Where the crane operator takes the mold from the closing station and places it on the floor, or where the jib and hoist assist the molder or helper in the carry-out. Also where a number of molds are placed on a long frame, or skid, and are taken from the molding station by the crane.

Skids and Trucks: Electric or gasoline. Where the molds are loaded on skids by the molder, with a lift truck for moving the skids to the pouring zone, and then to the shake-out station, returning skids and flasks to the molder.

Gravity Roll Conveyor: Where the molder places the molds on the conveyor, which conveys them by gravity to the pouring zone, then to the cooling zone, and thence to the shake-out station. Empty flasks are returned to the molder on a second run of conveyor. In some cases air cylinders have been used to push the molds along the conveyor.

Circular Table: Where the molder places the molds on a circular platform or frame supported by rollers or central pivot frame. The table is then moved by hand or power, the molds being poured, cooled, and shaken out as it moves around. The diameter of the table is governed by the number of molders, the number of molds to be poured at one time, and the amount of cooling time required.

Various Types of Foundries

The most common application of the power type mold conveyor is in gray and malleable iron foundries, while the cranes, jibs with hoists, skids and trucks, and gravity roll conveyors, will be found in the steel as well as in the nonferrous foundries. Circular tables are working to advantage in car wheel, radiator, piston ring and nonferrous foundries.

As it is necessary to have a sand handling system working in conjunction with the mold conveyors to get their full benefit, it is almost impossible to give the exact savings chargeable to the mold conveyors alone. The following items cover combination sand and mold handling equipments in a continuous gray or malleable iron foundry:

Production methods in the foundry: Continuous operation results in a steady flow of materials and products. Cleaning room, machine shops and all finishing departments benefit by a systematic, orderly foundry. Better service is secured on rush orders.

Flexible production for rush seasons: Output doubled by working night shifts. This results in more than double saving as it is accomplished on original investment. Double shift is not possible under old floor methods where the sand preparation is done at night.

Reduction of losses due to continuous inspection: Castings can be inspected 10 minutes after molds are made. Under the old method imperfect castings, due to poor sand, patterns, or metal, are not discovered until a day's production has been poured. This one item alone saves a tidy sum, and should receive consideration in working up anticipated savings.

Standard flask equipment: It is possible to standardize more on the flask equipment, as a larger volume of sand in some flasks will not affect molding costs. The sand hoppers over molding machines solve this problem.

Savings in flask and molding equipment: A reduction of 75 per cent in flask equipment is obtained on a continuous unit over the old floor method. At the same time the production in molds is increased. In some installations the savings in equipment have covered the cost of the sand handling system.

Molders' efficiency increased 60 to 65 per cent, due to the following: Delivery of sand to molding machines from overhead bins, eliminates shoveling. Conveying molds away from machines eliminates walking and bending to place molds on floor. Time used for pouring and shake-out is used for molding. Continuous molding all day is possible, with no loss of time waiting for iron, when floor is filled. It gives the good and speedy molders a chance for high production, by not using up their energy in shoveling and long carry-outs. Sand, free of shot and refuse, is better conditioned. Working conditions are bettered.

Work Done During Day

Elimination of night shifts: In foundries where the shake-out and conditioning of sand is done by a night gang, it has been possible to omit this shift entirely, saving from $100 to $150 per night. Where this work is done by the molders, its elimination gives to them that extra time for molding.

Floor space saved: A complete continuous unit would require less than 30 per cent of the floor space of a floor type foundry and at the same time have double capacity.

Operators become specialists at less cost: Due to continually performing one operation, the men find short cuts and become experts in their part of the system. A large percentage of the work formerly done by molders can be done by common laborers.

Minimum mold breakage: There is less tendency to break a mold in placing it on a mold conveyor than there is when the molder carries it out and sets it on the floor. This is true, especially if it is necessary to stack snap flask molds, on account of lack of floor space.

Systematic pouring reduces cost: Continuous pouring requires the minimum number of men working through the entire day on the pouring gang. It does away with the extra labor required when a large volume of metal is poured in a comparatively short time. Shortest possible carry for the metal, as the pouring zones on the conveyor are located adjacent to the cupola.

(*Concluded on Page* 839)

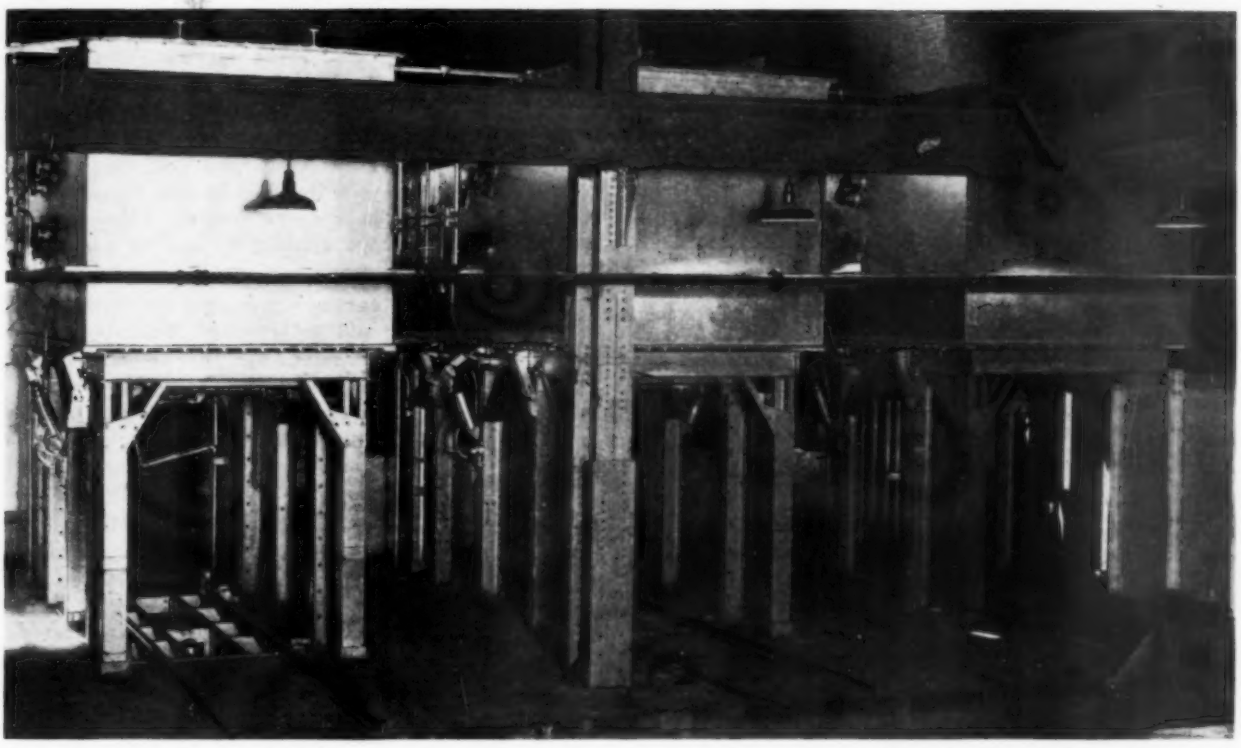


Fig. 1—Three Electric Annealing Furnaces of the Overhead Type Are Used in the Short Annealing Cycle

Shortens Malleable Anneal

High Temperature with a Quick Drop to 740 Degrees Cent. Decreases Heat Treating Interval to 28 or 30 Hours

FOR a number of years considerable effort has been devoted by producers of malleable cast iron and other investigators to develop a method which would decrease, to a large extent, the time necessary to anneal or heat treat white cast iron of the proper composition and convert it into the commercial product known as malleable cast iron. The mechanism involved in converting the white or hard iron into the blackheart or malleable cast iron includes the absorption of free cementite into the solid solution of iron and carbon, and the precipitation of the absorbed carbon from the solid solution as a form of graphite called temper carbon.

Some time ago the General Electric Co., Schenectady, N. Y., began an investigation to learn something of the mechanism of carbon precipitation with a view of a possible shortening of the process. Their efforts were successful and resulted in the development of a short-cycle annealing process whereby the time required is between 28 and 30 hours. Investigation showed that the absorption of free cementite into solid solution was a question of temperature and time.

At 1100 degrees Cent. (2012 degrees Fahr.) it was found that solution was effected in approximately 15 minutes while at 900 degrees Cent. (1652 degrees Fahr.) it took about 30 hours. With only a drop of 50 degrees from the highest temperature or at 1050 degrees Cent. (1922 degrees Fahr.) it took 8 times as long to effect solution or two hours. At 1000 degrees (1832 degrees Fahr.) the time required was 12 times that at 1100 degrees or 3 hours. However, the higher temperatures are too close to the softening point of the iron to result in much commercial value while temperatures below 900 degrees Cent. (1652 degrees Fahr.) are too low for rapid absorption of cementite.

After data was obtained on the absorption phenomena, it was necessary to study precipitation of the carbon. As in the case of absorption, precipitation also is related to time and temperature, and it was found that at 900 degrees Cent. (1652 degrees Fahr.) practically no precipitation had occurred at the end of 100 hours. Lowering the temperature increased the precipitation rate which reached a maximum between 750 and 700 degrees Cent. (1382 and 1292 degrees Fahr.) Below 700 degrees precipitation of carbon is retarded and at 650 degrees Cent. (1202 degrees Fahr.) no precipitation is evident.

With data at hand on the minimum time required for solid solution and the maximum rate of carbon precipitation, experimental 130-kilowatt electric annealing furnaces with a capacity of 2000 pounds of castings were built by the General Electric Co. to try out the method on a commercial scale. These furnaces were operated until recently when a new installation of three 325 kilowatt electric furnaces with a capacity of 6 tons was put into operation at its Erie, Pa., plant. The heating elements of the furnaces are nickel-chromium and are arranged to be connected in 3-phase or single phase to give a power

Fig. 2—Control Panel for the Furnace Installation

range of 52,170 or 325 kilowatts. The weekly capacity of the furnaces is 100 tons, and the average annealing cycle is 28 hours.

The furnaces which are shown in Fig. 1 are overhead type into which the car containing the castings, shown in Fig. 3, is elevated. Essentially, the process consists in rapidly heating the castings to the maximum temperature which is 1000 degrees Cent. (1832 degrees Fahr.) and holding at this temperature for 4 hours. The temperature of the castings then is reduced to 740 degrees Cent. (1364 degrees Fahr.) in 4 hours. The castings are held at 740 degrees in another furnace for 4 hours and then the temperature is dropped to 730 degrees Cent. (1346 degrees Fahr.) and held at this temperature for 4 hours. At the end of this period the temperature is lowered to 720 degrees Cent. (1318 degrees Fahr.) and the castings held at this temperature for another 4 hours. The castings then are removed and allowed to cool in the air or in a cooling furnace.

Test bars are included with each heat and these are removed at various times and examined to follow the heat treatment. These bars are arranged in step form with the largest section 2 inches square and decreasing in 3 steps to 1½; 1 and ½-inch square. On completion of the annealing cycle at 730 degrees Cent. stage some of the castings are fractured and examined. If the examination shows that the annealing is not satisfactory due to faulty composition of metal or other reasons, the temperature is raised to about 800 degrees Cent.; the castings allowed to soak for a short period and then the temperature is dropped to 740 degrees, etc. This secondary treatment will require about 15 hours more, making the complete cycle 43 hours.

May Vary Order

While the furnaces are placed parallel as shown in Fig. 1, and it would appear as though the end furnace would be the high temperature furnace, the second the cooling furnace, etc., this does not necessarily hold. Reasons for this are twofold. First, due to the ease of control and rapid heating up of the furnaces, any one of the three installed may be used as the high temperature furnace, and second, the variation in time of heating up and holding temperature time intervals may change the position of the high and low temperature furnaces.

Previously it was stated that the castings were held at the high temperature (1100 degrees Cent.) for 4 hours. Actual time in the high temperature furnace is about 11 hours. Seven hours of this interval are required to bring the castings to the required temperature and the remaining 4 hours devoted to insuring all castings reaching a uniform temperature and allowing sufficient time for absorption of the free cementite as mentioned earlier. At the end of the 4-hour holding period in the high temperature furnace, the car containing the castings is lowered to the floor and shifted to the cooling furnace.

Air cooling during the shifting of the car and the lower temperature in the furnace brings the temperature of the castings down to 740 degrees Cent. (1364 degrees Fahr.) in 4 hours. At this temperature the drawing operation begins. That temperature is held for 4 hours, dropped to 730 degrees Cent. and held for 4 hours, and then dropped to 720 degrees Cent. and held for 4 hours. Then the castings are allowed to cool in air.

Physical properties obtained on castings annealed by this method are said to compare favorably with these obtained by the ordinary annealing process. Results given show a tensile strength of 56,000 pounds per square inch; a yield point of 34,300 pounds per square inch, and an elongation of 15 per cent in 2 inches.

Other features are claimed for the process. The castings are said to be machined better than those obtained in the ordinary anneal. Also the castings show no signs of framing or reversion. There is claimed to be little skin on the castings and that they clean somewhat easier than those annealed in the regular way. Castings can be quenched directly from the 720 degrees Cent. (1328 degrees Fahr.) draw with increased strength without brittleness. It is stated that the castings may be galvanized without embrittlement and that they need no previous heat treatment or ageing. Also, warping of castings is less than that encountered in other annealing processes. Advantages claimed for the method are that it does not require boxes and packing material; hard cleaning (if desirable); less labor; less inventory; short delivery; cleaner operation; annealing not over two days behind the melting furnace; less space; composition (hard iron) control, and lower cost.

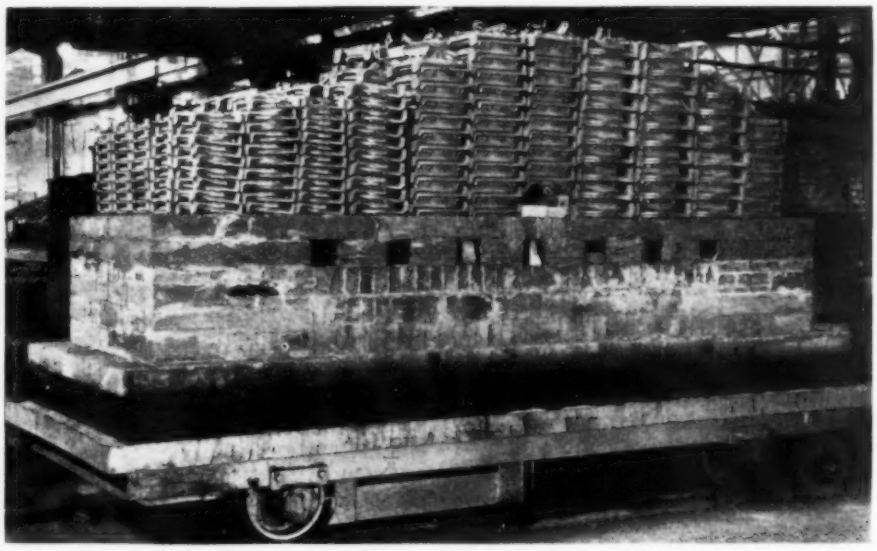


Fig. 3—Castings Are Packed on a Car With a Refractory Top and Elevated Into the Furnaces. Boxes May Be Used if Desired

PRESSURE DIE CASTING ALLOYS Must Meet Requirements

By Sam Tour

PRESSURE die casting is defined as the making of castings by the forcing of molten metal under pressure into metallic molds or dies. This article discusses the requirements which aluminum-base alloys must meet to be suitable in the pressure die-casting process and the effect of various impurities in the alloys.

The consumer's requirements may be classified briefly under the following headings: Strength, hardness, ductility, resistance to attack, permanency, machineability, adaptability to special finishes, polishing properties, appearance, weight, and cost.

A study of these requirements in a specific case usually narrows the field of alloys available to the producer to a few alloys with which he has had experience. The alloys also must be considered by the producer from the viewpoint of requirements imposed by the pressure die-casting process, his particular type of equipment, and his experience.

Gives Classification

The producer's alloy requirements may be classified briefly under the following headings: Adaptability to the type of machine available, melting point, fluidity, range of solidification, strength at elevated temperature, ductility at elevated temperature, solidification shrinkage, cooling shrinkage, rate of attack on iron containers, rate of attack on die materials, sensitivity to impurities, and limits of impurities.

All of these may of course be summed up under the one term, *pressure die castability*. In general it is this summation that the producer considers, and he of necessity must consider it in the light of his own past experience with the different alloys. In a field of metallurgy where so little information is given out as in the pressure die-casting alloy field, there has been little, if any, opportunity for one producer to discuss experiences with another producer. The result has been that each producer has arrived at his own viewpoint of the alloys and has developed his practice and his equipment in line with this viewpoint. A secondary result of this has been that for a given set of consumer's requirements, one producer finds one alloy most suitable while a second producer finds a different alloy most suitable.

Lists Properties

ALUMINUM-BASE alloys, when used for die castings, must meet certain definite requirements, such as strength, hardness, ductility, resistance to attack, permanency, machinability, adaptability, and finish. This article, which is the first of two abstracted from a paper presented at the 1929 annual meeting of the American Society for Testing Materials held at Atlantic City, N. J., discusses the effect of various steps in the die casting process on these alloys and points to the relation between alloy specifications and the effect of impurities. The author is vice president of Lucius Pitkin, Inc., New York.

Certain considerations should be borne in mind in formulating specifications for die-casting alloys. Specifications, for example, which limit zinc content in an aluminum-base alloy die casting to 0.75 per cent would indicate that a higher zinc content would affect adversely the desired properties in the finished casting. No authentic information to support this is available. Such requirements place undue burden on the producer without any advantage to the consumer. When a specification allows 0.3 per cent impurities other than iron and zinc in an alloy, it indicates that impurities in that amount will not adversely affect the properties of the finished casting. Yet we know that the properties of aluminum alloys are affected greatly by small amounts of magnesium, manganese, etc. In this case the requirement places an undue burden on the consumer. Specifications which place limitations on either the producer or consumer without corresponding advantage to the other party to the contract are harmful.

Traces Metal Needs

In considering the required properties of pressure die-casting alloys from the production standpoint, let us start with virgin raw metals and follow them through to the finished casting. If iron pots are used for alloying, there will be a certain amount of iron picked up in this operation. The alloy must be such that this iron plus the iron which will be picked up later in the pressure die-casting process itself will not be detrimental. If silicon in the form of metallic silicon, nickel as nickel shot, copper as copper clippings, etc., are used, some over-heating of the metal to effect good solution is inevitable. Also some oxidation will take place and fluxing and skimming off of dross should be practiced. Fluxes employed on aluminum usually contain zinc chloride or magnesium chloride or both. Their use introduces into the aluminum certain amounts of zinc and magnesium. The alloy must be such that these additions will not be detrimental. When the alloy is ready for the pressure die-casting machines, about 0.3 per cent of iron has been picked up and a trace of either magnesium or zinc, also unknown amounts of gases and oxides.

In die-casting machines, iron melting pots and iron pressure retorts are used and there is the inevitable iron pick-up from them. The alloy must be such that it does not too readily attack these machine parts and also such that the iron picked up

here will not be detrimental. On the average about 0.5 per cent of iron is picked up here from the time the metal is put in the machine until it is made into a casting. If the alloy is one which requires a high casting temperature or if the design of the casting and the die is such as to require a high casting temperature, the rate of attack on machine parts will be greater and the iron pick-up will be greater. In addition to this iron pick-up, the metal has also taken up an unknown amount of gases and oxides.

Fills the Mold

Air pressure suddenly applied, forces the metal to enter the die, filling the gate, runners, casting cavity, vent and over-flow cavities. The entire operation of filling is accomplished possibly in a fraction of a second; the molten metal traveling at high velocities through the constricted inlet and through the thin sections of the casting. Undoubtedly when the metal begins to enter the cavity and before the cavity is filled, there is considerable breaking up of the metal stream into individual globules or drops of molten metal. The metal must be such that the individual particles will join together again to form a continuous unbroken casting free or reasonably free from run marks and other surface imperfections.

The venting of the air in the die as the metal rushes in usually can be arranged so as to avoid large air pockets, and inlets can be distributed so as to eliminate swirls to a considerable extent, but even under these improved conditions some alloys will give much better surface finish than others. Where surface finish is of considerable importance, as is the case with a large percentage of the output of the pressure die-casting industry, it is often necessary to change from one alloy to another to obtain the desired result. Often it is impossible to predict from a study of the casting itself and of the arrangement of the inlets, vents, etc., which alloy will give the best surface appearance. The best alloy must be found by trial, choosing of course those alloys which will give castings of the required properties.

It is often surprising what great effects are produced by small variations in alloys and by small amounts of impurities. In many cases 0.05 to 0.10 per cent magnesium will make good surface finish impossible. Iron content below 1.25 or 1.50 per cent sometimes makes good finish impossible. Iron abnormally high often has a similar effect. Oxides in solution and gases in solution no doubt have important effects, but the necessary methods of analysis have not been available to permit of any statements concerning their effects.

Molten metal impinges on various portions of the die, sometimes directly and sometimes obliquely, and the metal must be such that it will not unduly attack and erode the die materials. Graphite, oils, clay washes, mica preparations, etc., are used to coat the dies periodically to assist in withstanding this attack. Great differences are found, however, in the alloys in this respect. Temperature, both of incoming metal and of the die proper, is of course of fundamental importance. Size of inlets with respect to weight of metal passing are also of importance. In addition, however, the properties of the alloy are important. Here we find that iron has great effect. Alloys low in iron sometimes will ruin the most expensive die in a few hours, while alloys with iron at 1.5 to 2.0 per cent will give no trouble at all. Some high-silicon alloys seem to have a much greater tendency to attack the dies than other alloys lower in silicon. Although iron might correct this trouble with high-silicon alloys, its presence cannot be allowed in a sufficient amount as it ruins the mechanical properties of the alloy in the finished casting.

Fluidity of Molten Metal

The instant the metal enters the die it begins to cool. The alloy must have sufficient fluidity and range of fluidity and semi-fluidity or plasticity between allowable maximum casting temperature, as limited by its effect on machine parts and die materials, and final solidification to allow of complete filling of the die cavity. What affects this fluidity? In some aluminum alloys, paricularly the copper-aluminum and silicon-aluminum alloys, iron to a limited percentage improves flowing properties. The higher the copper content, the less is the effect of iron with regard to this property. In the silicon alloys the iron, however, is more apt to act to the detriment of the mechanical properties in the final casting. Sometimes foreign matter, such as dissolved gases, suspended oxides, etc., cuts down fluidity, and a good fluxing with zinc chloride or magnesium chloride is helpful in restoring it. But here again a new trace of zinc or magnesium is added to the metal.

When the metal solidifies in the die it does so from the surface inward to the center of the sections as cast, during which the natural solidification shrinkage takes place. The surface is fed from the center of the section and natural solidification shrinkage therefore concentrates in the center of the sections and causes porosity. Feeding by means of risers as in sand-casting or permanent-mold casting practice is impossible. Porosity at least equal to the liquid shrinkage from casting temperature to solidification temperature plus solidification shrinkage must be present in pressure die castings. The alloy, then, should have as small a liquid shrinkage and as small a solidification shrinkage as possible.

Little Information Available

This raises the question as to which alloy additions to aluminum decrease and which increase solidification shrinkage. Meager information is available in this field. We know that in making certain rich aluminum alloy hardeners, rising of the ingot or exudation occurs. This is considered sometimes to indicate that the alloy expands on solidfying, but recently it has been shown that this phenomenon is associated quite closely with the amount of dissolved gases in the molten metal just before solidification and the ability of the metal to retain these gases on solidification. Nevertheless, in a given case it is often found that porosity in the center of a perfectly vented section varies with different alloys. It, of course, varies considerably with the degree of superheat of the metal. The higher the casting temperature above the final solidification temperature, the greater is the porosity.

The alloy must therefore not only have minimum liquid and solidification shrinkage, but it must have fluidity at as low a superheat as possible. Indications are that silicon here is an important factor as is also iron, manganese and magnesium. Silicon seems to increase fluidity and decrease shrinkage provided iron is kept to a proper proportion. Iron in amounts increasing from 1.50 to 3.0 per cent in copper-aluminum alloys with copper decreasing from 14 to 4 per cent seems to decrease shrinkage to some extent, Manganese with medium low silicon and low iron seems to be beneficial, whereas with higher silicons it sometimes seems harmful.

Combined with the questions of shrinkage and porosity, is the question of gases in solution in the molten metal and the ability of the alloy to retain these gases on solidification. Pressure die casting requires alloys which will not absorb undue amounts of gases while liquid and which have the property of retaining as much of the gases as possible on rapid solidification. The rapid chill-

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Gases Collect in Center

Although the rate of solidification is high, there is nevertheless some segregation, and the last metal to solidify is more highly charged with gases than the first. Surplus gases which cannot be held in solution are therefore concentrated at the center of the section, causing additional porosity to that caused by shrinkage. These gases accumulate in the center of sections under considerable pressure, in some cases sufficient to cause a growth of the casting after it is removed from the die. If the gas accumulation is near the surface and the casting is removed from the die rather hot, the gases expand locally and cause blistering. Often blisters are due to air entrapped by the metal plugging the vents.

After the metal has solidified in the die, the properties that are important are coefficient of expansion or rather contraction, hot shortness, ductility and strength of the alloy. By contraction is meant the actual contraction that the alloy would have in cooling from the temperature of solidification down to the temperature of removal from the die, if the casting were allowed to cool unrestrained. In pressure die casting the steel dies do not allow for any actual contraction during this period, and therefore the solidified metal must stretch an amount equal to this contraction. The hotter the die and the sooner the casting is removed from the die after solidification, the less stretching will take place. The time interval between forcing in of metal and opening of die and removal of casting is a great variable. In cannot be too short as the metal must be solidified completely and must cool enough to develop sufficient mechanical strength to hold its shape before the die can be opened at all. If large sections are being cast around cores and slides, the metal must have sufficient strength to withstand the strains of removing these cores and slides. Aluminum alloys are weak near the melting or solidification temperature, gaining strength as the temperature drops. The time interval between filling the die and removing the casting must be such as to allow the casting to cool and gain strength.

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Removes Risers from Roll Casting

THE foundry of a steel mill near Chicago recently received an order for several large roll castings of 0.65 per cent carbon steel. The large size of these castings taxed the resources of the foundry departments, especially the cleaning room.

It was found that a riser almost as large as the casting would be necessary and since it was large, its removal presented a problem in cutting. Before beginning the operation, each casting was about 8 feet long and 5 feet in diameter with a 2-foot core. The riser was approximately half of this mass, the diameter of the riser being slightly less than that of the roll, due to an offset of 2½ inches at the neck. This necessitated a cut of about 19 linear feet through metal 1½ feet thick.

After making one cut, it was found that the removal of the riser had required 25 cylinders of oxygen and two of acetylene.

Preparations then were made to cut off one of these risers, using an oxygen lance in conjunction with the blowpipe. The casting was set up as shown in Fig. 2 and a light scaffolding erected. A manifold for the oxygen cylinders and several lengths of ⅛-inch pipe to use for a lance were provided. The casting was covered with asbestos paper and sheet iron to retain the heat. Asbestos paper also was placed inside the casting where the core had been removed.

Cutting then was started by drilling a hole through the riser near the neck with the oxygen lance and the cut progressed, the lance manipulated by the service operator aided by the blowpipe in the hands of the plant operator, Fig. 1. The entire job took only about 3½ hours, including the time for cleaning the neck of the riser and for moving the casting with a crane to put it in position for cutting. Removal of the second riser required only 18 cylinders of oxygen and half a cylinder of acetylene. Oxygen consumption was reduced to 9½ cylinders on the riser removed from the third casting.

FIG. 1—CUTTING THE RISER AIDED BY AN OXYGEN LANCE. FIG. 2—CASTING READY TO HAVE THE RISER REMOVED

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FIG. 1—CUTTING THE RISER AIDED BY AN OXYGEN LANCE. FIG. 2—CASTING READY TO HAVE THE RISER REMOVED

A variety of Castings Were Exhibited by the Gray Iron Institute

Exhibits Cast Products

Co-Operative Displays at National Metal Exposition Broadcast Information on Castings

THROUGH exhibits by co-operative groups and individual firms at the National Metal Exposition held in conjunction with the annual meeting of American Society for Steel Treating, engineers attending the convention and exhibition were shown the value of castings as engineering materials. Hundreds of technical men, who make the final selection of materials used in the design of various types of machines, learned, perhaps for the first time, the valuable properties of castings for certain classes of work. Displays were maintained by the Electric Steel Founders' Research group and the Gray Iron institute, and by numerous individual firms.

The first effort toward co-operative exhibits was made at the Philadelphia show in 1928, when the Electric Steel Founders' Research group and the Steel Castings Development bureau showed samples of castings made by their respective members. The interest displayed by the visitors at that show led the Electric Steel Founders Research group to exhibit again in 1929. Considerable floor space was used by that group at the interesting exposition held in the Cleveland public auditorium, Sept. 9 to 13.

The display of the Electric Steel Founders' Research group contained a variety of miscellaneous steel castings produced by member companies, which include the Fort Pitt Steel Casting Co., McKeesport, Pa., Lebanon Steel Foundry, Lebanon, Pa., Michigan Steel Casting Co., Detroit, the Nugent Steel Castings Co., Chicago, and the Sivyer Steel Casting Co., Milwaukee.

Steel castings designed to replace products made by other methods of fabrication, were shown. An interesting casting included in that group consisted of a special track for a railroad ballast machine. The casting, which is in one piece, weighs 114 pounds and has 12 machining operations, was designed to replace an assembly having 32 individual parts, and which required 164 machining operations, 21 assembly operations and weighs 113 pounds. A steel casting for a locomotive superheater was shown welded to rolled steel tubing. The casting was cut away to show the feasibility of that type of work, which now is being accomplished on a commercial basis.

Other castings shown at the exhibit included gears, dipper teeth, wheels, parts of machines, a float valve, a chuck, pulleys, etc. The castings shown were made from a wide variety of steels. Other interesting features of the display were a group of laboratory specimens and a selection of photographs showing various foundry operations. Photographs of the individual member plants also were included. The display was in charge of Major R. A. Bull, director, and C. N. Ring, assistant director of the group. Realizing that gray iron offers unusual properties for certain classes of engineering work, the Gray Iron institute, and a number of associated members furthered their educational campaign, which is just getting under way, through an interesting exhibit at the Cleveland show. This is perhaps the first time that technical men connected with the consumers of castings have found gray iron foundries represented at this yearly display of metals.

The institute display consisted of a variety of gray iron castings illustrating various uses of that material. Gears, heater castings, refrigerator castings, stove parts, truck and bus brake drums, dies, wheels, sprocket wheels, etc., were shown. One of the interesting features of the display was a tombstone made from gray iron and enameled in an ingenious way to imitate closely a monument carved from stone.

Castings which were shown at the booth of the Gray Iron institute were made by the Fulton Foundry & Machine Co., Cleveland; the Downington Mfg. Co., Downington, Pa.; Hamilton Foundry & Machine Co., Hamilton, O.; Frank Foundries Corp., Moline, Ill.; Euclid Foundry Co., Euclid, O.; Hill Clutch Machine & Foundry Co., Cleveland; Carondelet Foundry Co., St. Louis; Cleveland Co-Operative Stove Co., Cleveland, and the Forest City-Walworth Run Foundries Co., Cleveland. The display was in charge of

Arthur J. Tuscany, manager, and Fred H. Doolittle, representative of the institute.

Special castings in aluminum, malleable and steel were shown by individual companies. The bulk of the steel castings shown by these companies were heat resisting alloys developed for use in heat treating processes. The following companies maintained exhibits: Aluminum Co. of America, Cleveland; Chicago Steel Foundry Co., Chicago; Chrobaltic Tool Co., Michigan City, Ind.; Crucible Steel Co. of America, New York; Detroit Alloy Steel Co., Detroit; Driver-Harris Co., Harrison, N. J.; Duriron Co., Inc., Dayton, O.; Electro Alloys Co., Elyria, O.; Fort Pitt Steel Castings Co., McKeesport, Pa.; General Alloys Co., Boston; Jewell Steel & Malleable Co., Buffalo; Lebanon Steel Foundry, Lebanon, Pa.; Michigan Steel Casting Co., Detroit; Milwaukee Die Casting Co., Milwaukee; National Alloy Steel Co., Blawknox, Pa.; Nugent Steel Castings Co., Chicago; Ohio Steel Foundry Co., Springfield, O.; Sivyer Steel Casting Co., Milwaukee; Southern Manganese Steel Co., St. Louis; Standard Alloy Co., Inc., Cleveland; Wheeling Mold & Foundry Co., Wheeling, W. Va.

Groups Study Foundry Problems

TECHNICAL sessions of the American Society for Steel Treating, the Institute of Metals division of the American Institute of Mining and Metallurgical Engineers, the iron and steel division of the American Society of Mechanical Engineers, and the American Welding society were held in Cleveland during the week of Sept. 9 to 13. At several of the sessions problems were discussed which relate more or less directly to the foundry industry.

A technical session of the American Society for Steel Treating was held Tuesday morning, Sept. 10. Radcliffe Furness, Midvale Co., Philadelphia, acted as chairman and Dr. C. H. Herty, Jr., bureau of mines, Pittsburgh, as vice chairman. The first paper was presented by George Batty, research director, Steel Castings Development bureau, Philadelphia. He spoke of two methods used in the production of steel castings. The first method outlined was that in which the steel was melted without an appreciable boil by adjusting the components of the charge to produce a certain carbon content. In the second method, the heat is boiled by the addition of iron ore with a consequent loss of carbon. Mr. Batty favors the latter method because, in his opinion, the amount of scrap such as gates, risers, etc., that are used in the charge in most steel foundries makes that method advisable. The scrap usually has sand adhering to it and this tends to increase the opportunity for nonmetallic inclusions in the metal if the first mentioned process is used. The nonmetallic inclusions are discharged from the bath to a greater extent if iron ore is used to promote a boil. Mr. Batty also spoke of the production of alloy steel castings and the use of aluminum as a degasifying agent.

Major R. A. Bull, director, Electric Steel Founders' Research group, Chicago, in commenting on the paper stated that he was an advocate of the use of iron ore to produce the boil in a bath of electric steel. He was not in favor of a vigorous boil but considered a gentle boil to be the best. The addition of iron ore late in the heat is necessary sometimes but is not the best practice. The average rated capacity of electric furnaces is 3 tons. In a furnace of this size no ore should be added within 45 minutes of tapping time. Time is an important factor in that reaction and the late addition of ore is fast becoming a thing of the past. Regarding porosity, Maj. Bull was of the opinion that the mold rather than the metal was the cause of that defect. In commenting upon the use of aluminum as a degasifying agent, he stated that it was better to introduce it in the stream of metal at the mold than adding it in the ladle.

Miscellaneous Steel Castings Were Shown by the Electric Founders Research Group

George Comstock, Titanium Alloy Mfg. Co., Niagara Falls, N. Y., said that his organization had studied the effect of aluminum in steel and had come to the conclusion that alumina was not totally responsible for the reduction in physical properties where that metal was used as a degasifying agent. Although it may be a contributing factor, he was of the opinion that the different arrangement of sulphide inclusions where aluminum was and was not used was in a great measure responsible. He presented slides showing micrographs to substantiate his statements. In the steels where aluminum was used the sulphide inclusions were *streaky* and where it was not used the inclusions were in a globular form. In each case where the sulphides were of the streaky variety and the aluminum had been used, the physical properties were inferior.

Discuss Effects of Slags

The second paper by G. A. Dornin, Gathmann Engineering Co., Baltimore, entitled "Slags Produced in Steel Making—Their Effect on the Product and on the Process Itself," was read in abstract by the author. The paper dealt with the use of more than one slag in the production of steel and the methods of removal of the slags from the furnace. He expressed the opinion that the use of tilting furnaces would facilitate use of that process and that the cost might not be as great as expected. H. W. Gillett, director, Batelle Memorial institute, Columbus, O., spoke of the reasonableness of the procedure and stated that deoxidizers such as carbon that form volatile products were the kind to use if possible. Dr. C. H. Herty, bureau of mines, Pittsburgh, pointed out the difference between removing slag from a 20 and a 200-ton furnace. He stated that in some places in Europe five or six slags sometimes were used. He also said that for some types of metal only one slag was needed as the quality of the metal would be sufficiently good for its use under those conditions. H. M. German, metallurgist, Universal Steel Co., Bridgeport, Pa., also commented on the paper.

"Melting Practice for Three Types of Electric Steel" was the subject of the third paper by H. P. Rassbach, Midvale Co., Philadelphia. He spoke of the charge and melting practice used in producing plain carbon, simple alloy and complex alloy steels.

The Thursday afternoon session of American Society for Steel Treating was featured by the presentation of a paper on "Graphitization of Prequenched White Cast Iron." The paper was prepared by H. A. Schwartz, H. H. Johnson and C. H. Junge, National Malleable & Steel Castings Co., Cleveland, and was presented by Mr. Schwartz. The paper constitutes a study of the acceleration of graphitization produced by the quenching of hard irons before annealing. The authors conclude that the reactions involved in the process of graphitization are interfacial in character and represent the rate of solution of cementite in the metallic matrix. According to the material presented, the diffusivity of carbon in iron is not necessarily altered by the prequenching operation, but the migration of carbon is accelerated considerably, due to the increased number of graphite nuclei, with the decrease in migratory distance.

"High Strength Cast Iron" was the subject of a paper presented by E. J. Lowry, Detroit. The author points out the development that has been made in the production of high strength cast irons through mechanical methods and by the addition of alloys. In discussing this paper, W. J. Merten, Westinghouse Electric & Mfg. Co., East Pittsburgh, stated that the trend of improvement is following that of steel in introducing alloys into cast iron. Frederick G. Sefing, Michigan State College of Agriculture and Applied Science, East Lansing, Mich., in a written discussion stated that high test cast iron can be made in a regular cupola by increasing the heat.

Secondary Metals Symposium

Approximately 75 members and guests of the various societies jointly represented at the annual convention attended the first technical session of the Institute of Metals division, held at Hotel Cleveland on Tuesday morning. Papers devoted to several phases of the nonferrous metals industry were presented for consideration. "Reclaiming Nonferrous Scrap Metals at Manufacturing Plants," by F. N. Flynn, Milwaukee, in absence of the author was presented by R. E. Darby, Federal-Mogul Corp., Detroit. The author employed a brick lined cupola to reclaim lead, aluminum bronze, and red and yellow brasses, stating that the red and yellow reclaimed brass metal showed less than 0.10 per cent iron. H. J. Beattie, General Electric Co., Pittsfield, Mass., and Mr. Darby discussed the paper. Mr. Darby stated that he believed a water jacketed cupola would be less expensive to maintain and that the corrosive slags produced would cut the brick lining to a large extent. R. W. Drier, Michigan College of Mining and Technology, Houghton, Mich., mentioned some experimental work on electrostatic and flotation separation methods.

H. M. St. John, Detroit Lubricator Co., Detroit, presented a paper on "Utilization of Secondary Metals in the Red Brass Foundry." In absence of the author, the paper was outlined by Verne Skillman, Bohn Aluminum & Brass Corp., Detroit. W. R. Graham, Ohio Brass Co., Mansfield, O., criticized the paper on economic grounds, stating that it was not good policy to purchase outside scrap and compete with secondary metal smelters. He also stated that use of composition ingots gave better results than the use of purchased scrap.

Use X-Ray Examination

In a written communication Mr. St. John replied that he did not advocate purchasing outside scrap except such as obtained from customers of the foundry, and in this way the previous history of the metal was known. He also stated that the term secondary metal was broad and might necessitate the use of the term tertiary in an already complicated situation. P. J. Potter, Federal-Mogul Corp., Detroit, presented a paper on "Recovery of Waste from Tin-base Babbitting Operation." Major Hobley, United States war department spoke on the need for reclaiming scrap nonferrous metals.

Wednesday afternoon the Institute of Metals division, American Institute of Mining and Metallurgical Engineers held a joint meeting with the American Society for Steel Treating in which three papers sponsored by the institute and two by the society were presented. Paul D. Merica, International Nickel Co., New York, acted as chairman. "Radiography as a Tool in the Metal Industry," was the subject of a paper by W. L. Fink and R. S. Archer, Aluminum Co. of America. This paper was presented by Mr. Fink and described the uses of X-rays in determining defects in castings, etc. The paper was discussed by H. H. Lester, Watertown, Mass., arsenal; W. P. Davey, New Jersey Zinc Co.; Ancel St. John, consulting engineer, New York, and E. W. Page, Victor X-ray Corp., Chicago. All the speakers stated that X-ray equipment is being used more and more and would be used to a still greater extent in the future.

The meeting closed with a paper on "Effect of Heat Treatment on the Properties and Microstructure of Britannia Metal," by B. Egeberg and H. B. Smith, International Silver Co., Meriden, Conn.

Questions & Answers on FOUNDRY PRACTICE

GENERAL

Makes Plaster Patterns

QUESTION

I shall appreciate any information you can give me on the methods employed in making patterns for soil pipe fittings. I understand that the master patterns are made in sections and these sections are assembled in various combinations to form any desired shape.

ANSWER

The method you describe whereby the patterns for soil pipe fittings are made from several sections may be employed occasionally, but it is an open question whether it really is economical. Almost as much time is consumed in making a section of a pattern as in making a whole part. If several duplicate patterns are required, the first master pattern section must be made to a size that will allow for double contraction. This usually involves more or less trouble in size and shape. Probably the best method of making these fitting patterns is to make full size wood master patterns with suitable prints attached for the smaller sizes where the intention is to make the green sand cores in individual coreboxes. The patterns are split through the center and each half is molded separately and afterward mounted on a plate in the usual manner. The corebox is made by first taking a plaster impression of the pattern.

This impression serves as a pattern and is rammed in the cope half of a flask and rolled over. The inside is lined with wax corresponding in thickness to the metal thickness of the required corebox. A drag is rammed in place and the combined mold is rolled back with the drag underneath. The cope is lifted off. The plaster pattern is removed from the cope and the wax also is removed. Minor repairs are made if necessary and then the mold is closed and poured. The foregoing merely is a general outline and does not cover details such as fitting hinges to the corebox, or machining and fitting the patterns on the matchplates. If you are familiar with metal patternmaking practice this will serve as a foundation on which to proceed. If you are not a patternmaker, we suggest you secure the services of a man who is skilled in this form of work. To cover the subject properly would entail more space than we have at our disposal.

THIS department covers all problems relating to metallurgical, melting and molding practice encountered in making steel, malleable-iron and gray-iron castings. Questions submitted by bonafide subscribers to this department will be answered by members of the editorial staff of The Foundry, supplemented where occasion requires by the advisory staff whose personnel is as follows:

John H. Hall—Cast Steel
H. A. Schwartz—Malleable Cast Iron
J. W. Bolton—Gray Cast Iron

All questions should be addressed to The Editor, The Foundry, Penton Building, Cleveland.

Q & A

Iron Blows from Chills

QUESTION

Some of our chills are bedded in cores, others in green sand. Can you advise us of some treatment or method that will prevent the iron from blowing off them?

ANSWER

In a general way it may be said that iron blows from a chill for two main causes: dampness or rust. Remove these causes or prevent them and you will have no further trouble. Specific methods of accomplishing this purpose depend to a considerable extent on local conditions, size and shape of the chills, their relative position in the mold, temperature of the sand and length of time the chills remain in the mold. These features can only be worked out by a person on the job and familiar with all the conditions. Hot sand will cause chills to sweat, irrespective of how they are coated, but for ordinary conditions a light coating of oil, tar, chalk, or shellac generally is sufficient. Where danger of burning to the chill exists, a coating of wet blacking is applied and the chill is dried thoroughly in the oven before it is placed in the mold. A light coat of rust or thin film of oxide will cause more commotion than a wet chill. See that the chill is cleaned before it is painted.

Q & A

Ratio of Tuyere Area

QUESTION

I should like to have some information that will assist me in operating a small home made cupola 20 inches in diameter inside the lining and provided with three 3-inch diameter tuyeres about 16 inches above the bottom. Do you think an 8-inch fan running at 1800 revolutions per minute can deliver a sufficient quantity of air through a 3-inch pipe for a cupola of the size indicated. What is the proper weight of iron and coke charges. What is the best method of cleaning the metal and keeping the slag in the cupola while melting all kinds of old junk including rusty stove plate and burned railroad grate bars. What is the total weight of iron than can be melted in a 20-inch cupola?

ANSWER

Your combination of dirty iron and a small cupola is bound to cause trouble in any heat that extends over an hour unless great care is observed and the necessary precautions taken to remove the slag as fast as it accumulates. Your last question dealing with the amount of iron that may be melted in a small cupola is best answered by referring to a record established at one time by Edgar A. Custer who operated a 24-inch diameter cupola continuously for 49 hours. The bottom then was dropped because the

brick lining had burned almost through in the vicinity of the melting zone. Small cupolas operated in connection with bessemer converters melt iron continuously day in and day out. There is no such thing as a limit in the sense that a cupola inevitably will choke. With a mild blast that will not chill the slag and with a sufficient supply of a suitable flux to render the slag liquid so that it will flow readily through the slag hole, the furnace may be operated indefinitely.

Your statement that you have an 8-inch fan running at 1800 revolutions per minute is not sufficient on which to base an opinion. A 20-inch cupola will melt approximately 1000 pounds of iron per hour and this will require a fan capable of delivering about 250 cubic feet of air per minute at 6 to 8 ounces pressure. Your main line and tuyeres are too small, especially the tuyeres. We suggest you provide a 4-inch pipe from the fan to the windbox and also cut at least three additional tuyere holes through the shell. Rectangular tuyeres flaring on the inner ends will provide a better distribution of the blast than round tuyeres.

Place a sufficient quantity of coke on the bed so that when it has burned through and settled down it will extend about 2 feet above the tuyeres. Then add 6 inches and charge the first iron directly afterward. Succeeding charges of coke and iron will be in the proportion of 40 pounds of coke to 400 pounds of iron. The iron must be broken into small pieces and charged evenly to present a level surface for the coke. About 10 pounds of limestone also broken small should be added to each charge. Cut a slag hole at the back of the cupola about 4 inches below the tuyeres and if necessary change the amount of limestone a few times until you secure a slag that runs readily.

STEEL

Risers on Alloy Steels

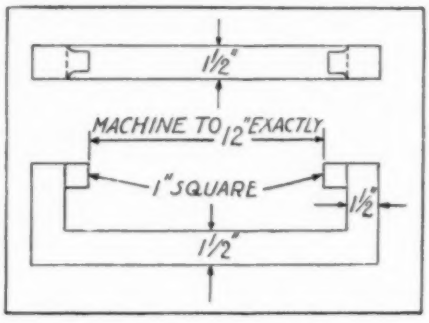
QUESTION

Have you any data on the amount of contraction to allow in constructing patterns for castings in stainless iron, stainless steel, and chrome-nickel alloys? Also should the risers be the same size or larger than those for a casting made in cast iron or in plain carbon steel?

ANSWER

The risers used for these metals should be of about the same size and proportions as those in steel casting practice. To use such comparatively small risers as are frequently used with success on cast iron castings, would lead to the loss of many castings from unsoundness. These metals are for the most part rather sluggish, and prone to become gummy at a temperature at which medium carbon steel is still quite fluid. This applies particularly to the alloys of low carbon content. For this reason, the heads on such castings as cannot be poured at the maximum temperature, should be larger than those used in steel foundries where the head dimensions are held to a minimum, to avoid the possibility of the head freezing too early and failing properly to feed the casting. The necks of the heads, if such are used, should be made large enough to guard against the danger of their freezing prematurely and preventing the head from feeding its metal to the casting.

The contraction to allow is approximately ¼-inch to the foot. This figure may vary slightly for some of the alloys, and it would be best to determine the shrinkage definitely for any



CONTRACTION IS DETERMINED BY MEASURING THE LENGTH WHEN COOLED

given type by casting a bar 1 x 1 x 12 inches between the ends of a rigid cast iron yoke molded in the sand such as illustrated herewith, and measuring the length of the bar when it has cooled.

MALLEABLE

Carbon Is Too Low

QUESTION

We are having difficulty with low carbons in our malleable iron. The carbon runs around 2 per cent and we would like to get it up to 2.50 per cent. We are using 4800 pounds of pig iron and 5000 pounds of old annealing pots with 100 pounds of lump coke.

ANSWER

The main reason for your low carbon is due to the use of the old annealing pots. These pots if they are anything like the ones generally discarded are mostly iron oxide. This material has practically the same effect as throwing the same amount of iron ore into your furnace. In other words as the pig iron and the little metallic iron left in the pots becomes molten, the iron oxide in the charge rapidly attacks the carbon to form carbon monoxide and metallic iron. Hence the best thing for you to do is to replace the old pots with a better type of scrap material.

You might be able to increase the carbon content of your mixture by putting petroleum coke or graphite on the furnace bottom before charging. However, this method requires high temperature, and the slag will have a tendency to prevent the absorption of carbon. You might try melting the metal first. Then clean off the slag and cover the molten bath with petroleum coke. Raise the furnace temperature as high as possible and then rabble the coke into the bath to promote intimate mixing.

GRAY IRON

Silicon Reduction Helps

QUESTION

What is the maximum tensile and transverse strengths to be expected from a cupola mixture composed of 35 per cent steel scrap, 35 per cent pig iron, 30 per cent cast scrap and a small amount of monel metal? The analysis of this heat runs 1.40 per cent silicon, 0.085 per cent sulphur, 0.20 per cent phosphorus, 0.75 manganese, and 1.0 per cent nickel. The castings are dense and machine well, and give 4300 pounds transverse strength and 33,000 pounds per square inch tensile strength. If possible I would like to increase both values. In melting, the first charge is laid in the following order: Steel scrap, monel metal, pig iron and cast scrap. All other charges are laid: Pig iron, steel scrap, monel metal and cast scrap.

ANSWER

As far as we are aware there is no standard yardstick whereby you can state definitely what the maximum tensile and transverse strength of any cast iron mixture will be. Many factors enter in such as the temperature of pouring, melting conditions in the cupola, condition of scrap used, etc. As examples, two specimen test bars containing about 25 per cent steel gave a transverse test about 4400 pounds; another test bar containing the same amount of steel gave 4714 pounds transverse, and a fourth showed only 4170 pounds transverse. The tensile strengths of these bars showed an average of 33,000 pounds per square inch for the first two; 35,000 for the third and 39,700 pounds per square inch for the fourth.

You probably can increase both your tranverse and tensile strengths by reducing your silicon and increasing your nickel on the basis of 1 nickel for each 0.50 silicon. However, since you are using monel metal as a softener, you may have to use different ratios. Coleman in a paper presented before the American Institute of Mining and Metallurgical Engineers

states that small amounts of copper aid machinability, and Hurst reports that small amounts of copper will have no effect on the physical properties of cast iron.

As mentioned the physical properties may be increased by reducing the silicon, but this should be done cautiously, watching the effect upon machinability. As long as the castings machine easily the silicon may be reduced until the reduction makes itself felt. At this point, you will have to stop otherwise you will have a deluge of complaints from the machine shop.

In your method of charging, we advise following the placement of materials as stated for the first charge. This is: Steel, monel metal, pig iron and cast scrap. That is the method usually employed when steel scrap additions are made. We presume that you are using a mixing ladle at the spout to obtain the full benefit of uniform metal.

Q & A

Chills Sprocket Iron

QUESTION

We have an order for a large number of sprocket wheels in which the rim is to be chilled, but the hub must remain soft enough to machine. All our iron is soft and we shall appreciate your opinion on how to meet the foregoing conditions.

ANSWER

Your only problem is to reduce the silicon in the iron to a point where the iron will chill, that is hold the carbon in the combined form, when it comes into contact with the iron face of the mold. The actual silicon content will depend on the thickness of section of the casting. For example, a 2.00 per cent silicon iron will chill in a ½-inch section while the silicon content in car wheels is less than 1.00 per cent. The silicon content in your mixture may be lowered by the addition of steel scrap, old car wheels, crusher scrap or any other form of ferrous metal in which the amount of silicon either is negligible or quite low.

Q & A

Furnace Arms Crack

QUESTION

We are having considerable trouble with the cast iron base of a warm air furnace on account of the arms cracking. These small *S*-arms connect a fairly large plate with a light outside ring. The castings are poured from an iron mixture that contains from 2.25 to 2.75 per cent silicon and 0.50 to 0.80 per cent phosphorus. Do you think the fault lies with the design or with the metal?

ANSWER

This is one of the castings in which contradictory strains are set up during cooling on account of the shape. The comparatively light rim cools before the center. The light, crooked arms yield slightly to the contraction strain and then set rigidly. The center contracts later and since neither the rim nor the arms will come any farther, the iron at some point either has to stretch or break. The arms are the weakest and naturally they break first and relieve the strain. Some irons will stand more strain than others even when poured into castings that defy nearly all the natural laws. Other irons will crack under the slightest provocation. You do not give a complete analysis, therefore we cannot determine whether the iron or the design of the casting is responsible for the cracked arms. If the casting has been made successfully in the past, it is apparent that the iron is at fault at the present. If you are trying out a new pattern, the fault may lie either with the pattern or the iron.

We suggest you reinforce the arms slightly and try a few castings with your present mixture. If the arms continue to crack, or if the heavier arms cause the rim to crack you may place the blame confidently on the iron and change your mixture to one that will afford more elasticity. What you need is an iron high in silicon and comparatively low in sulphur and phosphorus. A good dose of bessemer iron or charcoal iron in the mixture will cure the trouble.

Q & A

Withstands High Heat

QUESTION

Kindly send us the analysis of the best kind of iron for an oval pipe 5 feet in length, 12 inches on the long diameter and 3 inches on the short diameter, with a ¾-inch thickness of metal. These castings are used in considerable numbers in sugar refineries and are subjected constantly to a temperature that ranges between 900 and 1800 degrees Fahr.

ANSWER

On account of the severe service to which these castings are subjected their life is comparatively short even when made from the most satisfactory material. Usually they are made in jobbing foundries and poured from what is known in these shops as the regular mixture, that is approximately half and half pig iron and scrap. The proportion varies occasionally, depending on the general character of the scrap that is available. Experience has shown that a low sulphur and phosphorus content makes the most satisfactory type of casting, principally because it prevents the casting from cracking until after a period of maximum service. For that reason it is advisable to use a certain proportion of bessemer malleable pig iron in the charge. The sulphur and phosphorus also may be reduced by the addition of steel scrap. The addition of nickel and chromium in small amounts is recommended in the manufacture of castings subjected to high temperatures. Information on this phase of the subject may be secured from the advertising pages of THE FOUNDRY. An approximate analysis for the castings follows: Silicon 2.00 per cent, sulphur 0.06 per cent, phosphorus 0.20 per cent, manganese 0.70 per cent.

Q & A

Wants Elasticity

QUESTION

Can you give us any information on the proper gray iron or semi-steel mixture for producing high quality bull ring, cylinder bushing and ring pot castings? These castings must possess elasticity and have wear resisting properties. They also must be close-grained with a brinell hardness about 220 and be machined easily. We have been experimenting with nickel mixtures, but as yet have not found just what we want.

ANSWER

One of the large locomotive firms makes cylinders and bushings from a mixture of pig iron, cast scrap and steel scrap which will give a composition containing 1.0 to 1.5 per cent silicon. Test bars are poured from the cupola metal in heavy chills, and should show a chill from ¼ to ½-inch. The bars are 1¾ x 2 x 12 inches. Another composition given for bushings contains 1.25 to 1.50 per cent silicon; sulphur, low as possible; phosphorus, 0.30 to 0.60 per cent, and manganese, 0.70 to 0.90 per cent. In mixtures of this type usually 20 to 25 per cent steel scrap is added to the charge.

If you prefer to continue the use of nickel, the following mixture is claimed to give excellent results: 400 pounds steel scrap; 300 pounds chilled car wheel scrap, 300 pounds malleable bessemer pig iron, and 16 pounds nickel shot. This should give an analysis as follows: Silicon, 0.67 per cent; manganese, 0.42 per cent; phosphorus, 0.142 per cent, sulphur, high; nickel, 1.47 per cent.

While the various cast irons mentioned previously could be used for castings such as the bull ring and ring pot castings, it is suggested that you make them a little softer by increasing the silicon. This will allow the greatest wear on the rings rather than on the liner.

Problems in Nonferrous Founding

By Charles Vickers

Aluminum Causes Dross

We experience difficulty from dross when making nickel silver castings in the form of a ring 42 inches outside diameter. These dross spots are distributed along the circumference of the ring at various parts. The casting otherwise seems to be particularly dense and does not show any porosity. Only nickel silver ingots were used in making the casting. We send a section cut from a casting to better illustrate this condition. Can you tell us the cause of this trouble?

Aluminum is the cause of the trouble. It confers on the molten metal the property of lathering like soapy water. The metal may be skimmed cleanly, and before pouring be in perfect condition but still the castings come out of the sand filled with this dross because wherever the fluid in filling the mold impinges against a wall of sand, or drops to lower depths, or one stream hits another, there is agitation, and agitation forms lather. The pits and larger cavities are a part of this lathering phenomena. It is all well for us to write that the nickel alloy should be free of aluminum to get clean castings of this size, but no doubt the aluminized nickel silver is on hand and cannot be thrown away.

Remembering this lathering property now possessed by the alloy, the problem is to so enter it into the mold without agitation which makes such dross. This means it must enter at the bottom and gently rise to fill the mold. In the case of a skirted ring like the casting in question there is no bottom, so something else must be done. If for instance, the gate is located on the outer diameter of the ring, then after the mold is made and closed ready to pour, it is elevated on the side opposite the gate, and at this point a riser has been placed. The molten metal will enter at the lowest part of the mold, and climb inclines to fill the mold space and finish up in the riser. Evidently then it will have filled the mold gently, and there will be no agitation to make this dross. As it is likely some dross will form at the bottom of the sprue, due to the drop of the metal it will be a good idea to avoid a direct flow from sprue to gate. The mold had better be skin dried so there will be nothing to cause the metal to simmer as it lies there just before solidifying. This simmering will also cause dross.

Q & A

Uses Lost Wax Process

We wish to cast some small busts by the lost wax process. We would like to learn of any books dealing with this subject, or other literature describing the process in detail. What kind of wax is employed and what facing material is used in contact with the wax? We have made several trials but find that the impression dissolves, or is eaten away in places in the sand on melting out of the wax, leaving the casting more or less imperfect. We have tried a facing of black lead made into a paste with molasses water, also we have mixed this with various proportions of fine molding sand, but have not as yet hit upon anything that will give us a perfect casting.

Sand, such as used in ordinary molding is unsuited for making the molds used in the lost wax process because it is difficult to ram it to make a perfect reproduction of the wax figure without distorting the pattern. Also the bond added to the sand, burns out leaving the mold too weak and friable to resist the weight and heat of the molten metal. The medium used is plaster of paris, but used alone, plaster of paris is too *close* and would blow in contact with the metal. It is necessary to mix some material with the plaster to render it porous so the gases developed by the hot metal can escape. One mixture used for casting molds consists of one part of plaster of paris; two parts finely powdered brick dust, mixed with water to a creamy consistency so that it can be cast around the wax pattern. Other materials such as finely screened carborundum fire sand can be used in place of the brick dust. Molds made of such material are likely to crack in firing and various means are taken to prevent this. One old patent covered the use of asbestos mixed with the plaster, and another covered the use of coal ashes, finely served and used 50-50 with plaster of paris. This patent No. 813,605 was issued to Joseph G. Weyer, February 27, 1906, who claimed it to be greatly superior to asbestos and plaster of paris, and to make a mixture that could be dried quickly without cracking.

When the mixture of plaster of paris and asbestos is preferred, the two ingredients are mixed together in equal proportions for brass or bronze casting. The short fibre asbestos not the long stringy grade should be used. Some time before being used the asbestos should be mixed with water to the consistency of a cream, and it should always be kept in this state. When wanted for the mold it is mixed with plaster in the proper proportions. If the objects are to be hollow the wax will have to be molded over the core, and the latter must be suspended in place in the mold by wires which protrude through the core, and the wax, and extend so as to be embedded in the plaster of the mold. Openings must be left through the mold through which the melted wax can flow. An important part of the process is to dry the mold thoroughly. This can be done in an oven starting at first with a gentle heat, so the excess of water held by the plaster is driven off slowly. About 300 degrees Fahr., is used first, and when most of the water has been driven off, this is gradually increased to 1000 degrees Fahr. This process requires time, nothing is gained by hurrying it, otherwise the casting will show blows.

For the wax, use yellow beeswax, the shrinkage of which can be controlled by adding Venice turpentine, about one ounce to the pound of wax with a few drops of glycerine to increase ductility. It will be necessary to make a plaster piece mold from the original pattern, to be able to duplicate the wax pattern that is *lost* in making the mold.

The FOUNDRY Family Photograph Album

Upper Left

W. B. ANDERSON

Buckeye Iron & Brass Works, Dayton, O.

Lower Left

J. B. RIPLEY

J. B. Ripley Brass Foundry, Windsor, Vt.

Upper Right

C. W. GWYN

Safety Grinding Wheel & Machine Co., Springfield, O.

Lower Right

F. J. OTTIS

Northern Malleable Iron Co., St. Paul, Minn.

HINTS FOR THE CORE ROOM

SANDS

Many types and kinds of sands have been and are being used for core purposes. It has been quite customary to use whatever sands are available locally. The research sponsored and carried on by the American Foundrymen's association recently has brought the importance of a careful study of sands to the foundrymen's attention. It has been proven that sands (both core and molding) are the cause of many foundry troubles as well as numerous bad castings. This means that a careful study of the properties and behavior of the sands used for cores will result in improved foundry practice.

Sands are classified according to their origin geologically, such as glacial drift sands, river sands, sea sands, lake sands, dune sands, and sandstone deposits.

Glacial drift sands (often called bank sand) are deposits found in the glacial drift of northern United States and Canada. They were deposited by the rivers and streams as a result of the melting of the receding glaciers of the last geological period. They are essentially river deposits and are composed of grains of varying size and shape. They usually contain considerable quantities of fines, lime, and clay content. The fines and lime content cause an excessive bond consumption, and the fines, the varying grain size and shape greatly reduces the venting property of the sand. This type of sand has good green bond and is often used for this property alone. However, for intricate work, and jobs requiring good permeability it is not a desirable sand. A typical chemical analysis and screen test of a Wisconsin bank sand is as follows:

Silica	90.42 Per Cent
Iron Oxide and Alumina	5.84 Per Cent
Lime and Magnesia	3.59 Per Cent
Volatiles	0.15 Per Cent

Mesh varies greatly and usually contains considerable material finer than 100 mesh.

River sands are those found along river banks and in old river beds. The fineness is quite irregular. They contain appreciable quantities of fines, lime and clay, all of which are detrimental to economical bond ratios and permeability.

Sea sands are sands found along sea shores. They are quite free from fines, lime, and clay content and the grains are well rounded. They do contain small quantities of alkalies (salts) which are moisture absorbing

(*Continued on Data Sheet No.* 784)

HINTS FOR THE CORE ROOM

(*Continued from Data Sheet No.* 783)

and therefore these sands must be used with some care. A typical analysis is as follows:

Silica (SiO_2)	98.00 Per Cent
Loss on ignition	0.50 Per Cent
Acid solubles	0.80 Per Cent
Lime ($CaCO_3$)	0.40 Per Cent
Chlorides	0.30 Per Cent

92 per cent on a 65 mesh screen.

Lake sands are somewhat similar to sea sands except that they usually contain considerably more lime, but no alkalies. The sands known as lake sands are usually those which have been pumped from lake bottoms but also include those found along lake shores. The sands pumped from the lake bottoms contain considerable quantities of lime (shells) and organic matter. They are also quite irregular as to fineness. These characteristics prevent economical bond ratios, greatly reduce the permeability, and give cores that blow readily. A typical analysis of a lake sand is as follows:

Chemical Analysis	Per Cent	*Screen Analysis*	Per Cent
Silica (SiO_2)	80.45	Held on a 20 mesh	none
Iron oxide and alumina	9.80	Held on a 40 mesh	1.00
Lime	5.20	Held on a 70 mesh	37.25
Magnesia	0.40	Held on a 100 mesh	34.05
Loss of ignition	4.15	Held on a 140 mesh	20.05
		Held on a 200 mesh	7.35

Dune sands are wind blown lake and sea sands. The wind action resorts the sands, removing the fines and aiding the weathering action in removing the lime. Therefore these deposits are composed of rounded grains of quite uniform size and contain small amounts of undesirable impurities. They will analyze from 95 to 99 per cent pure silica and contain relatively small amounts of fines (60 to 95 per cent between 20 and 100 mesh). These sands are considered best for core purposes and are used in synthetic molding sands. A typical analysis is as follows:

Chemical Analysis	Per Cent	*Screen Analysis*	Per Cent
Silica (SiO_2)	95.65	Held on 10 mesh	none
Iron Oxide (FeO)	0.42	Held on 20 mesh	0.52
Alumina (Al_2O_3)	1.76	Held on 40 mesh	5.37
Lime (CaO)	0.65	Held on 70 mesh	80.70
Magnesia (MgO)	0.58	Held on 100 mesh	11.72
Sulphuric Anhydride	0.38	Through 100 mesh	1.11
Organic matter and volatiles	0.56		

(*Continued on Data Sheet No.* 785)

THE FOUNDRY DATA SHEET, OCTOBER 1, 1929

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Producing Steel Castings in the Modern Foundry

Part IX

By Charles W. Veach

THE location of the core room should be such that the stream of cores flowing in the direction of the molding room may move along a channel where the progress is impeded least and with the least possible interruption of operations in the molding room. Core handling is costly both from the viewpoint of labor and the expense occasioned by breakage. Cores often are removed from cars and placed in storage, then loaded on racks and transported by crane to the molders. Double handling involves a large labor expense and many cores are made unfit for use by having their edges broken. This defect always does not cause a bad casting but it invariably causes extra chipping expense.

Avoids Handling Expense

To avoid handling expense, one progressive core room foreman thought of a plan whereby larger core cars were provided. Instead of the racks being permanently fastened to the cars, they were removable and interchangeable. His plan was to make and load as many different kinds of cores used on a certain design of casting as the car would hold. After the cores were baked, removed from the oven and cooled sufficiently, the racks were transported to the gang of molders using them.

Larger racks make the task of transporting the cores to the molders easier, eliminate loading and unloading, and reduce the number of trips made by the crane, thus allowing it more time to serve the molders. The plan also saves valuable space.

The layout of the core room should be such that the materials may move in a constant stream through the department. Storage bins for sand and binders should be near the machines used for preparing the sand. A layout of this kind is shown in Fig. 13. After the sand is milled and tempered properly, it is conveyed to hoppers. Benches for four coremakers are located between each pair of hoppers. Cores are loaded directly on the cars which run on narrow gage tracks extending the full length of the room. This layout requires a minimum of lost motion by the coremakers and those handling the cars. After the cars are loaded, they start on their way, first to the silica spray and then to the ovens.

Describes Coreroom

A COREROOM is one of the necessary adjuncts of a steel foundry. Location and layout are factors that have a decided bearing on the efficiency of that department and on the cost of production. In this the ninth of a series of articles on the production of steel castings in the modern foundry, the author deals with the selection of materials for the manufacture of cores and discussed their baking and distribution. He also discusses some of the problems that face the coreroom foreman.

Adequate light is indispensable in a core room and ventilation is of paramount importance. Cleanliness also is significant. These factors contribute much to the quality and volume of work done in a core department. That they affect the cost of cores, no one will question. There are other items which affect the working conditions in a core room, tend toward the contentment of the men and make the task of supervision less strenuous. These are having plenty of auxiliary material on hand when needed, such as wires, chills, arbors, etc., and giving proper instructions in regard to unfamiliar work.

It is the core room foreman's duty to study the preparation of sand for the various kinds of work to be made, and impart this knowledge to the men that mix the sand. He should be sure that the mill man knows exactly what is desired. If the milling operation is neglected, many poor cores result. Tempering is more important than milling and if not carefully watched may result in sand that is too wet or too dry. An insufficient amount of core binder often is the cause of bad work but too free use is a waste of costly material.

Must Select Sand

Too much care cannot be given to the selection of core sand. Where castings are designed in such a manner that they have a tendency to tear or crack this defect may be aggravated greatly by the quality of the sand and the kind of material used as core binder. If the cores are surrounded by metal they must be open, and must offer the least possible resistance to the contraction of the metal when it cools. Cores which remain hard after the metal solidifies and begins to shrink cause cracks and are difficult to clean out. Underbaked cores especially tend to cause shrinkage cracks because they develop strength as the metal rises around them when the mold is poured.

Core binders, like any other material used in the manufacture of steel castings, should be selected from the viewpoint of their utility and not because they are cheap. In certain classes of work, cores are playing a more and more important part. In continuous work, such as the production of railway equipment, the number of cores used in molds for certain castings have doubled and even trebled during the past few years. This has been brought about by newly designed castings which give more strength but make the molding problems more difficult. Some of the new designs require as many as 36 cores in a mold, and many of the cores are large and almost entirely surrounded by metal when the mold is poured.

Since some cores are placed in such position that they offer little or no

resistance to the shrinking metal when it cools it is obvious that various types of core binders can be used without running the risk of having the castings develop shrinkage cracks. It also can be seen that cores which offer resistance to the natural shrinkage of the metal should be bonded with a material that will allow the core to fall off in strength as soon as the metal has formed around it and solidification takes place.

There are several axioms that must be remembered when baking cores. One is that the time required to develop maximum strength decreases as the temperature increases; that cores should be used for this purpose. When a record is kept of the heat condition of an oven throughout the period that a charge of cores has been baking, the man in charge of the ovens will know the exact time the cores were charged and the heat record will indicate whether or not the cores are ready to discharge at the end of the predetermined period. It will show whether the burner has a tendency to overheat or to lag. It also will indicate better than any skilled oven tender is able to judge when the flame should be increased or reduced.

The usual foundry method of judging whether cores are properly baked they do the molders. They cause the core-room foreman to think in terms of money instead of cores.

Even when the layout of the department complies with the rules of latest development, there always are situations cropping up which require considerable thought on the part of the foreman to handle them in the best manner. Making short cuts is a proposition facing executives in every department of industry.

Fig. 14 shows a core box that presented a problem to the core foreman. When the core box was delivered to him by the pattern-shop foreman, the two metal pieces which set loosely in

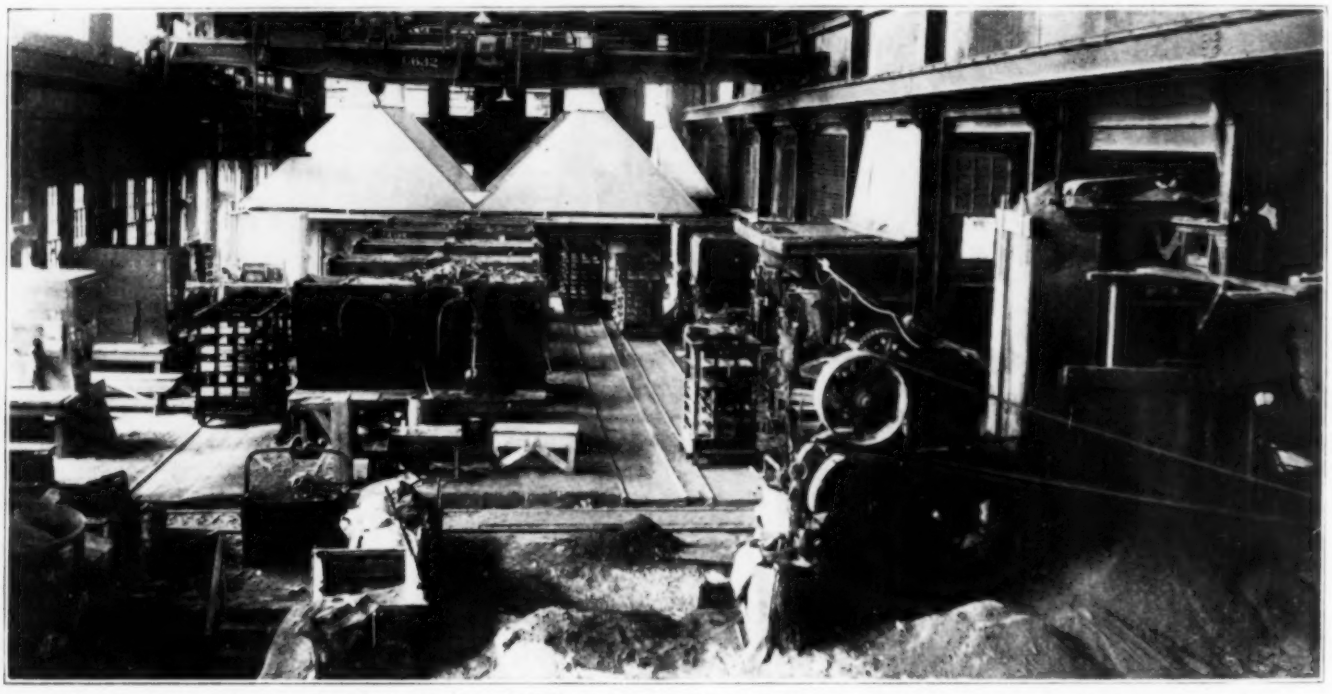


FIG. 13—SAND AND BINDER SHOULD BE LOCATED NEAR THE MILLS WHICH PREPARE THE SAND FOR THE CORE ROOM

deteriorate if baked too long; that the rate of deterioration increases as the baking temperature increases and that the development of maximum strength is affected little by premeability.

Some practical men believe that permeability does affect the time required for a core to attain maximum strength. It seems reasonable that open cores will dry more easily than those that are closed. Experience has shown that no matter how hot the ovens may be when the cores are introduced, they will not become hotter than 212 degrees Fahr. until the moisture has been expelled. It also can be affirmed that less damage will occur to open cores when introduced into an overheated oven than will occur to cores less open when subjected to the same condition.

If the baking temperature is the major factor in attaining maximum strength, temperature control is important. Recording thermometers is to test sharp edges for strength or hardness. This method is nothing more than rule-of-thumb and fails completely to distinguish between cores baked to maximum strength and cores underbaked. Those not quite done may show hard, strong surfaces but the centers still may be soft. Such a core placed in the mold where the metal surrounds it, will have a tendency to cause a crack.

The core room foreman does not think in terms of cores, but of cost. This perhaps is not true always, but it does hold in a shop where the work is continuous. Most continuous work is done on stripper-plate or bumper machines. Certain patterns are interchangeable on these machines. The job demanding earliest shipment first will be run. However, an order which must be shipped on a short time limit may be made for a few days then taken out to make room for one equally as pressing. These changes affect the coremakers much more than the end had not been provided. The impression piece shown at the side of the core box came with the box. That was to be hammered down to make the impressions after the core was rammed. As submitted by the patternmaker, the job was difficult because the points where the impressions were located, were filled with sand when making the core, and this had to be removed before the impression piece could be hammered down.

That job was made on a bumper machine and, by using false impression pieces, production was increased 25 per cent, the work of the coremaker was made easier and a better core was produced.

Fig. 15 shows a view of another core box, which presented a ramming problem for the core room foreman. This was a ring 20 inches in diameter, 8 inches deep and 2 inches thick. The thin section was too narrow to admit an ordinary rammer butt. The problem was to find a method of ram-

ing the core by hand. The core room foreman devised a rammer butt of wood, 10 inches long, 1½ inches diameter, and having a shank 1½ inches long. This proved an efficient tool, and lasted from 10 days to two weeks.

It was found that when the wooden rammer butt was used with the end sawed off square it had a butting effect, and the core sand was not rammed firmly. Rounding the end slightly and roughing the wood caused the rammer butt to have a peening effect and no further trouble was encountered.

Investigates Resistance to Corrosion

(*Concluded from Page* 820)

According to our investigations it can be concluded, that the physical structure of the graphite does not exert any appreciable influence on the rusting process, while even the general structure and the chemical composition (except in the case of high additions) influence only slightly the rusting of cast iron. This is verified by our own researches and those of the previously mentioned investigators. In this connection reference should be made to some comparative rust investigations undertaken by E. Piwowarsky on pipes cast by the centrifugal process and in sand molds, as they are in apparent contradiction to the results in this article.

In the corrosion of centrifugal and sand cast pipes buried in moist ground and in saturated ammonium sulphate solution, the superiority of the centrifugally cast pipe over the sand cast amounted to 20 per cent. This result could have been attributed to the finer graphite structure in centrifugal casting, had not the matrix in the two metals exhibited substantial differences. Inasmuch as the matrix of the centrifugal casting is made completely homogeneous through the subsequent annealing operation, the decided superiority might well be ascribed to this fact.

Cuts Production Costs

(*Concluded from Page* 824)

Casting collecting omitted: Castings are delivered to one point by the conveying unit, thus eliminating collecting and carrying around the entire foundry area.

Saving in new sand: New sand requirements are reduced materially, due to proper mixing and preparation. Minimum burning out of the sand results, as the molds are shaken out in shortest safe cooling time.

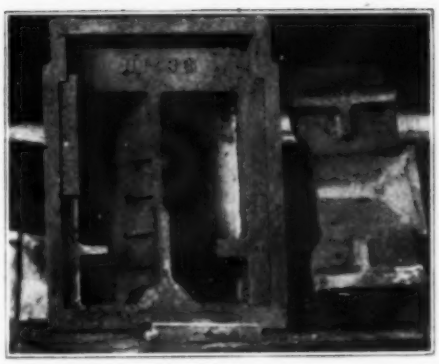


FIG. 14—USE OF LOOSE METAL PIECES MADE THIS CORE EASIER TO MAKE

Pace setter: Continuous operation tends to speed up production, and set a pace that can be maintained.

Although many of these advantages also are realized in steel and nonferrous foundries, the conditions surrounding each individual installaton, and the methods previously used, determine the saving. Needless to say, the profits realized by steel and nonferrous foundries fully warrant this type of equipment. The large number of foundries making this installation in recent years proves this point. Numerous records are on file showing a reduction in direct and indirect labor of more than 50 per cent.

Any foundry that has increased its volume of business to require new buildings can make a three-fold saving by the introduction of a conveying system in the old buildings. First: advantages gained are continuous or semicontinuous production. Second: the sand and mold handling equipment cost less than half what the new buildings would cost. Third: sufficient room will be saved in the old building to accommodate the extra core and cleaning room requirements needed for the increased production.

Success of these installations is dependent on having correct layout to meet individual requirements. Last but not least a rugged design of the various machines is needed to withstand the wear and tear of sand and iron during their transportation on them.

FIG. 15—NEWLY DESIGNED TOOLS AIDED IN MAKING THE CORE

Gray Iron Group Plans Annual Meeting

A tentative program has been announced for the annual meeting of the Gray Iron institute, which will be held at the Hotel Cleveland, Cleveland, on Wednesday, Oct. 16. Institute members and visitors will register Wednesday morning and at 10 o'clock will be welcomed to Cleveland by Mayor John D. Marshall. Reading of the minutes, reports of officers and reports of various committees will follow. The following chairmen of committees will report: Cost, J. L. Carter, Barlow Foundry Inc., Newark, N. J.; finance and budget, H. J. O'Neil, Western Foundry Co., Chicago; merchandising, Don McDaniel, Hamilton Foundry & Machine Co., Hamilton, O.; research, B. H. Johnson, Florence Pipe Foundry & Machine Co., Florence, N. J.; statistics, K. L. Green, Green Foundry Co., St. Louis; and trade practice, R. M. Hill, East St. Louis Casting Co., East St. Louis, Ill.

A special group luncheon will be held at noon at which all will be welcome. An interesting address will be presented by Dr. Hugh Baker, manager, trade association department, Chamber of Commerce of the United States, Washington. The subject of Dr. Baker's address will be "Your Trade Association and How it Can Help You."

Several important papers will be presented at the afternoon meeting. R. R. Cunningham, National Sales Development Service, Cleveland, will talk on "Group Merchandising and the New Competition." M. T. Harrison, executive officer, Stevens, Harrison & Jourdan, New York and Cleveland, will speak on "Labor Cost Control in a Jobbing Foundry." Mr. Harrison will discuss the system of predetermining molding and coremaking time allowances which make wage incentives possible in jobbing foundries.

The report of the nominating committee will be made by the chairman, Franklin G. Smith, Osborn Mfg. Co., Cleveland. Five directors will be elected, each to serve a term of three years. The report of the resolutions committee will be made by its chairman, Henry P. Spilker, Sterrit-Thomas Co., Pittsburgh. The remainder of the afternoon will be thrown open for the discussion of any problem of interest to gray iron foundrymen.

The annual banquet will be held at 7 o'clock in the Hotel Cleveland. An interesting program is being arranged and special entertainment will be provided. All interested in the gray iron industry are invited to attend the various sessions on Wednesday.

Bill Has an Inquiry on Foreign Sand

By Pat Dwyer

"IT'S the only racket in the world," Bill remarked the other night "where a guy who knows nothing about it can get away with his stuff."

"You will pardon my density," I replied, "if I fail to qualify as a mind reader. You may know what you are talking about. Privately I have my doubts. Considering all the-er-a-rackets that have sprung up since the piping times of peace descended on us I am inclined to the opinion that you are covering too much territory. Rackets and racketeering, at least up to the present, have not invaded my peaceful orbit. Such slight acquaintance as I have with the subject has come through an occasional glimpse at an item in the newspapers."

"Slight acquaintance is right," said Bill. "Any information you glean from the ordinary daily paper usually is slight and generally wrong. Some of the stuff may be O. K. According to the law of averages there must be a few grains of wheat among the tares, but a great deal of it, let us say charitably, is inaccurate. Maybe it is not wilfully inaccurate. It is written out of the depth of abysmal ignorance, but surely some person in authority should check such stuff for accuracy before it is printed." "Check is not the word," I interrupted. "He should chuck it out." "Right y'are me hearty," Bill agreed enthusiastically. "Where do you suppose I would get off if I passed defective castings? If one of my men turns out a botched job, loose pieces misplaced, strained out of shape and with more wings and fins than a flying fish, I send it to the scrap pile. If the evidence seems to indicate that the faker cannot do any better, I tie a tin can to his tail and speed him on his way. In this here now newspaper racket, a downy bird hands in a piece of tripe and not only is it accepted and printed, but the cuckoo's name is printed at the top in large, bold type so that even the weak and the halt and the blind can read it without either cane or glasses."

"Am I to infer?" I inquired at this point. "Am I to infer that this newspaper racket is the particular racket you had in mind when you said a few minutes ago, it is the only racket in the world where a person who knows nothing about it can—as you phrase it so elegantly—get away with his stuff?"

"Boy," said Bill, "you are improving all the time. I meant nothing else but."

"Why did you not say so in the first place?" I wanted to know. "If you only had sense enough to be a little more explicit in the beginning I would have taken your meaning immediately. As it is, I have had almost as much trouble as a boy smoking a badger out of a hole. Why did you not—"

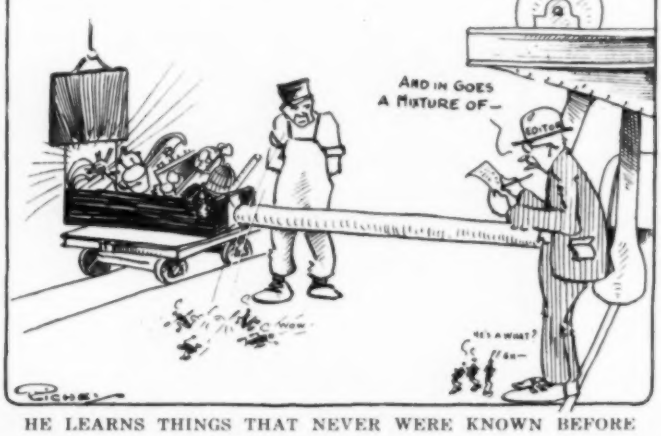
"A fat lot you know about badgers," Bill cut in. "The only way to catch a badger in a hole is to follow him with a steam shovel. Even then you won't catch him unless he brings up against a ledge of rock. I remember one time, me and Tubby Maloney—remember Tubby don't you?—"

"You told me that story before," I said. "How you and Tubby and the badger improved the initiation ceremony of Local 188 one night. Unfortunately the badger—a dumb brute according to Tubby—mistook inductor Tubby for the candidate and clawed the most of his pants off before he dove through a window. Other gentlemen in their hurry had carried the sash with them and brave Tubby's flight was unimpeded.

"Never mind going over the ground again. Stick to the straight and narrow path, one thing at a time and so forth. You started out with a most disrespectful reference to the newspaper, the main bulwark of our liberties and the great fountain of knowledge from which the people draw their daily dose of information. Have you any particular reason for running a course with sharpened lance against the newspaper, or are you prancing around just for exercise?"

"Well," said Bill. "I'll tell you. Two things I hate are a sloppy job and an attempt to put something over on me. The first offends my sense of craftsmanship and the second is an insult to my intelligence. Here is a story I read in today's paper. The lad who wrote it knew no more about the subject than my saintly aunt Jemina knew about shooting craps. However, there is this difference. My aunt Jemina just naturally would petrify any person who even suggested that she should describe the ancient and honorable African game of the rolling bones. The author of this piece in the paper, writes with all the assurance and innocence of a child who has seen a locomotive for the first time. "I clipped it out," Bill continued, "to add to my collection of curiosities. Here, take a look at it once." The clipping was headed:

GOOD OLD AUTO IS MELTED AND GONE! Where Are the Cars of Yesteryear? Read This



HE LEARNS THINGS THAT NEVER WERE KNOWN BEFORE

and You'll Know

By Rollo Kumagen

"Note the calm touch of assurance," Bill commented, "the note of authority, the master's voice. *Read this and you'll know.*

"With his remarkable gift for ferreting out items of interest—known among the profession as a nose for news, but among others in many instances as plain nosey impudence—our hero discovered that people are burning up with curiosity regarding the fate of old automobiles. As a plain matter of fact the average man is as much interested in the ultimate fate of his old automobile as he is in the newspaper in which he wrapped his shoes last week to send to the cobbler. However, as the fella says, that don't make no never mind. Rollo assumes that the public is parched for a few drops of precious information on this burning subject and in his great big hearted way he determines to give till it hurts. I don't know how it affected other readers, but I know his information gave me a generous pain. True to the noblest traditions of the service, which counts no cost or personal sacrifices too great where the sacred interest of the reader is concerned, he boldly invaded an open-hearth plant. What he saw there was plenty. In fact it was more than plenty. With his highly trained reportorial eye he saw things which men who have spent all their lives in open-hearth plants never saw. He saw—Oh well, here read the thing for yourself."

Where do the wrecked autos go? FIRST LOCATION—It was a long coffin-shaped box of hard steel and it was filled with all kinds of scrapped metal. There were smashed auto parts, rusty razor blades, broken up automatic guns, corset stays and still another big chunk of an auto motor. Along came the charging machine in the plant of the Orinoco Steel Co., last night. The charging machine moved majestically on two wide tracks and pushed the auto parts the razor blades and all into a furnace.

"Isn't that a gem?" Bill interrupted, "for accuracy and clarity? 'It was a long coffin-shaped box of hard steel,' he announces blandly out of a blue sky, 'and it was filled with all kinds of scrapped metal.'"

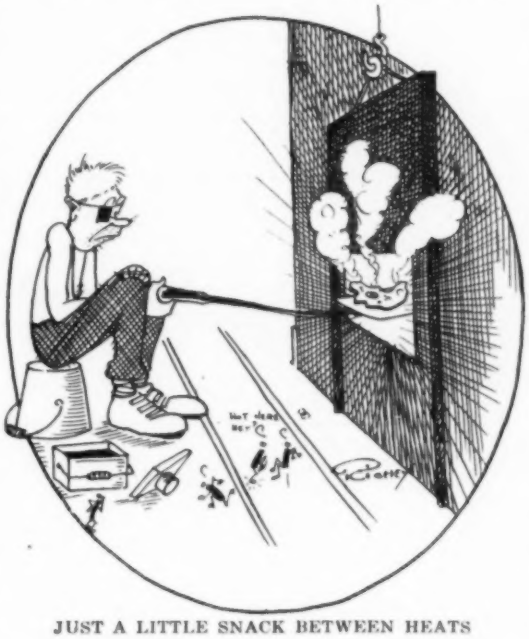
"A charging pan may be compared to any one of several familiar objects, but no person except a positive genius could see any resemblance to a coffin. 'Made of hard steel,' sez he. I wonder how he found out that secret!

"No modern newspaper story would be complete without a touch of sex appeal, hence the clever reference to the corset stays. Maybe he saw 'em and then again maybe he was thinking of something he saw in a museum.

"The charging machine—detail generously left to the imagination—came along on two wide tracks and pushed auto parts, razor blades and all into a furnace. Nothing could be clearer than that. The coffin was resting on a pair of trestles near the open furnace and the charging machine just pushed it in like Humpty-Dumpty falling from the wall. Just like that!"

"Try the next spasm."

Inside the furnace was a boiling lake of metal. The temperature was 1355 degrees Fahr. The furnace was hungry. Men with cobalt blue eye glasses peered in. The business of filling the furnace with things to eat was begun. The giant charging machine first had dumped in large tin blocks as large as 60 paving bricks. The tin was the aperitif for the gluttonous steel melter.



JUST A LITTLE SNACK BETWEEN HEATS

"Think of that!" Bill exclaimed. "The inside of the furnace was a boiling lake of metal at 1355 degrees Fahr. Steel melters all over the country who have been working their furnaces over 3000 degrees will be interested in this discovery.

"The practice of first filling the furnace with large blocks of tin as large as 60 paving bricks is another startling innovation. If that secret ever gets out it will revolutionize the manufacture of steel. At first I jumped to the conclusion that this heat of steel was to be rolled into tin-plate, but the next sentence showed me my error. The tin simply was the aperitif for the gluttonous steel melter!

"I have seen husky melters cooking huge slabs of meat on red hot shovels, and in the dear dead days beyond recall I have seen them rinse their gullets with a preparatory draft from a tin can, but apparently the modern melter is keeping up with the times. Having satisfied himself that all is well with the furnace for half an hour, he pushes his blue glasses up on his forehead and remarks languidly to the second helper: 'A little slug of tin, my lad, for an aperitif!'"

The furnace then chewed into its red sea of lava some ore and pig iron. Up came the charging machine, stuck out its long arm toward the cinder buggy box filled with the razor blades, the corset stays, the broken guns and the big chunk from the wrecked auto. It was a big night for shattered autos. The furnace door opened and the box whirled around once and came out empty. All the contents had sunk into the fiery lake.

"Apparently," said Bill, "the referee objected to the former rough, pushing tactics on the part of the charging machine. In this instance it stuck out a long arm toward the—get this—*cinder box buggy* filled with the razor blades, the corset stays, the broken guns and the big chunk from the wrecked auto. First the thing was a coffin and now it is a cinder box buggy. By some miraculous ledgerdemain the box—unlike Humpty-Dumpty—apparently was rescued from the fiery maw of the furnace. Here it is again with the same identical load, razor blades, corset stays, broken guns and the very identical big chunk from the wrecked auto! *This* time it does not escape. 'The furnace door opened, the box whirred around once and came out empty.' The charging machine stuck out its long arm toward the cinder box buggy. Nothing is said about engaging the end, therefore we reasonably may assume that the box jumped through the door of its own volition, whirred around once (how does a box whir?) and then dived out again."

Early this morning, bright liquid steel will run forth into ladles. The ladles will run to ingot molds. The steel will be run into sheets and bars. Nice new steel from old, old autos.

"The only run he missed," Bill remarked sourly, "is the run in the stocking. Everything around the place seemed to be running that night except his long, newsy nose. It is a great pity he did not stick around for a few hours to see all these runners in action. A flock of ladles running around the mill looking for ingot molds, is a sight that is not seen every day.

"What's the sense of printing such a tripey mess?" Bill asked. "It conveyed no information to the average reader and only excited derision in the minds of any steel men who saw it. If any of the Orinoco men saw it, I bet they blew a tire. The boss

melter probably carries the clipping around in his pocket. Any time the mill gets in a jam and he feels like crucifying the bonehead responsible for said jam, he will pull out the clipping and blow off steam in a great gust of Homeric open-hearth laughter."

"Why don't you write a sketch for the paper?" I suggested. "With your background of practical experience it should be worth while."

"Well," said Bill, "I'll tell you. I believe in sticking to my own trade. An ordinary letter is about my limit. I wrote one the other day to a foreign foundryman who was having trouble with his sand. For some time he has been importing Belgian sand and mixing it with Belfast sand to improve the venting qualities of the mixture and to secure a better skin on the castings. He finds that this sand does not work well unless it carries an excessive amount of water and this water in turn causes the sand to stick to the face of the pattern. Also the sand shows a tendency to wash in front of the advancing stream of iron thus producing dirty areas on the bottom side of the casting from where the sand floated away and on the top side where it landed eventually. He makes light and medium weight textile machinery castings which are machined extensively and which must present an exceedingly smooth clean surface. Most of the molds are made from plate patterns. He has been advised to strengthen his sand mixtures by the addition of clay. He would appreciate my opinion on this point, also any other information that will enable him to utilize this sand for the production of good castings.

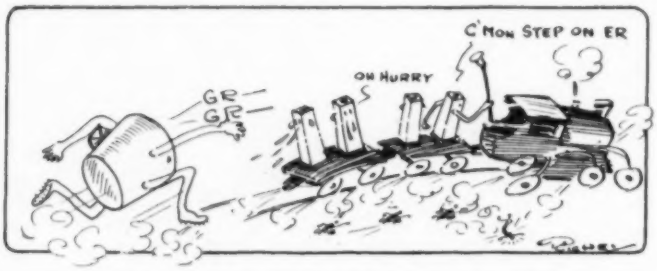
"Typical mixtures follow: Regular facing sand is made up of Belfast rock (milled) 1 barrow, Belfast red 3 barrows, Belgian yellow 2 barrows, used floor sand 6 barrows, coal dust 9 shovels. Filler sand is made up of Belfast red 2 barrows, Belgian yellow 2 barrows, used floor sand 6 barrows. This sand is put through a centrifugal mixer. A special strong facing sand contains Belfast rock 3 parts, Belgian yellow 1 part, used floor sand 6 parts and coal dust 1 part. This facing is milled.

"I hesitated to offer an opinion on sands with which I am not familiar and with foundry practice which seems to differ in some respects from that in America. Tinkering with the sand in a foundry is a tricky and delicate proposition and should not be attempted by any person without a full and intimate knowledge of all the conditions involved. Off hand I am inclined to the opinion that he is using altogether too much new sand both in the facing and in the floor sand. If, as I infer from the general statement submitted, the principal object of adding the Belgian sand was to increase the permeability, practically the same object might have been attained by adding a small amount of sharp sand. Also the amount of new sand in the facing should be almost sufficient to keep the heaps renewed without making them up in such an extravagant manner as indicated, half and half new and old sand, and two varieties of new sand at that.

"Whether or not clay should be added to the sand largely hinges on the relative cost of renewing the bond in the sand. Where new sand is cheap, experimenting with clay is not looked upon with favor by foundrymen. Where high sand costs have forced foundrymen to view the situation closely, marked economies have been reported through the exclusive use of clay as a reviving agent. However, experience has shown that all clays are not alike and that amateur experimenting in the dark is dangerous. Unless the clay is selected with care, with a full understanding of its properties and unless a careful check is kept on the rejuvenated sand daily for bond and permeability, the sand will become so *tight* that it will be practically useless for molding purpose.

"A series of six articles dealing with this subject in considerable detail appeared in THE FOUNDRY from March 1 to May 15, 1926. An interesting paper on the same subject from a pipe shop viewpoint was presented in the July 1, 1927 issue. He probably has copies of these back issues in his files. The subject raised in his inquiry really is too far reaching in its many ramifications to be covered in the scope of an ordinary letter. Also it is impossible to form a correct diagnosis at this distance and from the information submitted.

"Off hand I suggested he reduce the amount of Belgian sand in the facing until that sand may be used without excessive water. Replace the Belgian sand with an equal amount of used sand. By miling all the facing he will secure a maximum bond with a minimum amount of bonding material. Thus a milled mixture of one part new sand to 3 parts old sand will prove more workable and show an apparently higher bond than a half and half mixture of new and old sand, mixed by hand and thrown through a riddle. This feature is so well known that even when molders mix facing by hand, they tramp over the pile with their feet before they cut it over and riddle it. The advantage of milling the mixture of course is that the bonding strength is increased without reducing the permeability.



'TWAS CERTAINLY A GREAT NIGHT FOR THE RUNNERS

A. F. A. Installs Officers and Directors

Board of directors of the American Foundrymen's association held its annual meeting on Sept. 12 at the Hotel Statler, Cleveland. New officers elected at the Chicago convention of the association were installed at that meeting. They are as follows: Fred Erb, president, Erb-Joyce Foundry Co., Detroit, president; N. K. B. Patch, secretary, Lumen Bearing Co., Buffalo, vice president. The new directors elected for a three-year period also were installed. These are Samuel T. Johnson, vice president, S. Obermayer Co. and the National Engineering Co., both of Chicago, retiring president of the association; Arnold Lenz, assistant general manager, in charge of gray iron and malleable iron foundries of the Saginaw Products Co., subsidiary of the General Motors Corp.; Harold S. Falk, vice president and works manager, Falk Corp., Milwaukee; Delos Hollowell Wray, Henry Wray & Son, Inc., Rochester, N. Y. and Frank J. Lanahan, president, Fort Pitt Malleable Iron Co., McKees Rocks, Pa. Plans were discussed for the thirty-fourth annual convention and exhibition to be held in Cleveland at the public auditorium, May 12-16, 1930. Pictures made during the tour of the American party attending the Third International Foundrymen's congress in London last June were shown to the directors and invited guests, at an informal evening gathering.

Perry W. Olliver, formerly of the El Paso, Tex., office of the Sullivan Machinery Co., Chicago, has been appointed manager of the San Francisco office. He succeeds the late Ray P. McGrath.

Practice Affects

Cohesibility of Rammed Sand

While Conclusions Deal Specifically with European Sands, Nearly All Observations Apply to Sands Found in America

By Ivan Lamoureux

MEDIUM sand as taken from the quarry shows scarcely any cohesion. It does not readily form a lump possessing any consistence. The silica grains are bound together not in a uniform mass but by small colonies of argillaceous matter. The grains touch each other at their angles, leaving the natural binding material between them.

Object of treating sand is to distribute the clayey matter in a perfectly regular manner among the grains. By treatment in the mill—that is by rubbing the sand—each grain of silica is encased in clayey matter and the sand becomes plastic, thus acquiring its real binding property. The object of the aerator is to give the sand greater porosity and to increase its permeability.

Effect of sand treatment may be observed by rubbing it between the fingers for a few moments. Sand apparently weak at once becomes strong.

When sand is pressed on a flat surface the grains arrange themselves according to one of their largest faces. The binding material is pushed between the grains and the whole forms a smooth surface. This is why flat castings and horizontal surfaces generally present a smooth appearance.

Ramming the vertical walls to a certain extent tears the grains apart. Angular grains of sand adhere to the walls and turn around several times. When the ramming is finished, the surface actually is rough instead of being perfectly smooth. For this reason the vertical parts of a mold generally are less presentable and smooth than the horizontal parts. Whether the sand is rammed by hand, machine squeezing, jarring or slinging, the sand of the vertical walls will be rougher than elsewhere owing to the friction of the grains. Perhaps some day a method may be developed by which the sand will be pushed laterally against the pattern.

All patterns should be given as large a taper as possible. Certainly the founder will make no objection and the castings will present a much better appearance.

A board with the requisite section cut beveled generally is used in sweep molding. This board cuts the rammed sand and causes a superficial tearing which has to be remedied by pressing the sand with the points of the fingers and making several passes with the sweep. Afterward the surface is smoothed with tools. When the castings are molded in dry sand the molds are relatively sound, but in green sand molding, scabs or blisters frequently are found. The rammed sand has been impaired, its cohesion has been affected, and none of the methods of restoring it has proved effective. A portion of the pattern fixed to the spindle arm, against which the facing sand is rammed, is used in many American foundries for most cylindrical castings, instead of a beveled board.

After each portion of the mold is finished the pattern section is moved and the ramming is continued until the whole mold is finished. Castings with smooth surfaces are obtained in this way. The sand retains its cohesion and permeability, which always are endangered by the action of the sweeping board and tools. The same method is followed for the inside and outside of the mold.

Where castings of uniform section, machine tools, bedplates and frames of various types are made without patterns, the mold is swept by templates sliding on wood gages which determine the dimensions of the casting. In these instances also the founder will do well to employ the portion of a pattern, which can be moved as often as necessary. When the direct ramming of the walls has been effected the appearance of the casting will be very smooth and the mold will be perfectly sound.

A great deal of attention has been paid to the characteristics of the mold, but too often little regard has been paid to the runner. The runner receives the molten metal and carries it to the interior of the mold. Therefore it is subject to much more severe strain than the mold itself. If it is not perfectly resistant or if scabs are produced in it, the dislodged sand is carried into the mold and may spoil the casting. A cylindrical section is best because release of gases is effected by channels which are multiplied in number in proportion to their distance from the center. Runners of prismatic form frequently show scabs caused by passage of the metal. When the runner

(*Concluded on Page* 848)

Runs Belgian Shop

IVAN LAMOUREAUX, author of this exchange paper from the Association Technique de Fonderie de Belgique presented before the Institute of British Foundrymen comes from a long line of foundrymen, prominent in the industrial life of his native land. Previous to the war he was joint owner with his brothers and managing director of the foundry business known under the title of Lamoureux Freres. His two brothers were killed during the war and the plant was destroyed. In 1919 Mr. Lamoureux began the manufacture of foundry equipment and still is engaged in that business. He is past president of the Belgian foundrymen's association and manager of the Revue de Fonderie, published in Belgium.

Ivan Lamoureux

The Shakeout

DAN M. AVEY, *Editor*
FRANK G. STEINEBACH, *Managing Editor*
PAT DWYER, *Engineering Editor*
EDWIN BREMER, *Metallurgical Editor*
CHARLES VICKERS, *Nonferrous Editor*
NORMAN F. HINDLE, *Assistant Editor*

¶ More Light Needed

AUTUMN, with its pleasant days and cool nights, whispers the approach of winter. The shortening of the days brings again the problem of proper lighting to the manager of industrial establishments. Due to the particular requirements encountered in the foundry industry, special attention should be given to the subject of adequate illumination.

MANY foundries built in recent years have adequate provision for both natural and artificial ilumination. Newer buildings are provided with many windows to permit the sunlight to enter. However, unless the windows are kept free from dust and dirt arising in the operation of the foundry, they are almost useless. It might be profitable to clean the windows before cold weather sets in.

IF NATURAL illumination is not sufficient to permit workmen to do their best, ample facilities should be provided for artificial lighting. Great progress in solving industrial lighting problems has been made since Edison invented the first incandescent light 50 years ago, and the foundryman should be awake to the opportunity before him. An investment in lighting facilities pays dividends in many ways, but the chief benefits arise from more and better work and safety for the workmen.

¶ Let's Not Have Heroes

ACCORDING to a recent statement by Dr. Hugo Eckener, the famous world tour of the Graf Zeppelin was undertaken to prove the safety and utility of the lighter than air craft as a transportation medium for passengers and freight. Without a doubt, the safe arrival of the great ship at the home port in Friedrichshafen, Germany, proves those things for which the trip was organized. While much credit and praise goes to the able commander of the ship, the excellent crew and backers of the flight, Dr. Eckener is right when he begs to withdraw from the role of a hero. His belief that the commercial application of lighter than air craft will suffer a serious setback if it is necessary for one to become a hero to ride in that type of ship, is sound, and has been illustrated many times in the development of heavier than air transportation companies.

THE first commercial air lines organized were devoted to the transportation of passengers. In those days airports were few and far between, planes had not been developed to the present state of perfection and regulations were light. Passengers rode the air lines in most cases for the thrill always just around the corner. If the trip was safe, with no particular excitement, the passenger said little to his friends. But let something happen, such as a forced landing with an encounter with a tree, and the passenger was ready to tell the world of his adventure. In fact, he wanted to become a hero. As a result, few people would ride in commercial airplanes.

LATER, the government started the air mail, devoted to the transportation of materials, as contrasted with previous attempts to move people. Without the adverse publicity secured by the early passenger lines, the air mail grew, increased in efficiency and soon began the night and day schedule. When the government turned the air mail over to private companies, it was so well established with a record for safety, that it was not difficult to start the passenger business on a paying basis.

¶ Short Courses Profitable

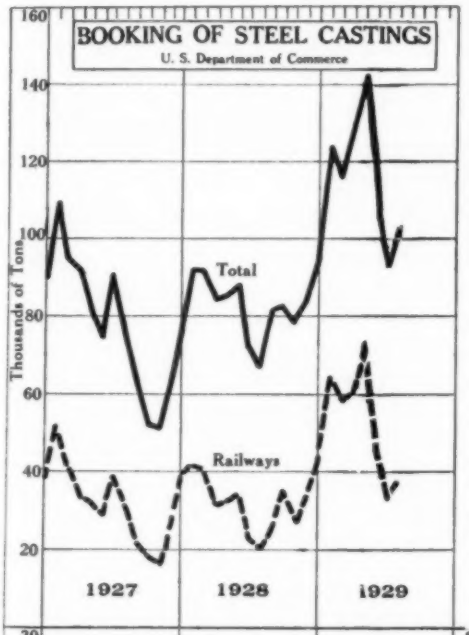
THE American Foundrymen's association differs from numerous other groups related to the metal working field in the diversity of interests represented in its membership. Foundry owners, plant managers, technical men, superintendents, foremen and manufacturers of equipment are included in the 2500 members of the association. For years the programs at the technical sessions have been arranged primarily from the standpoint of the plant manager and the technical man. However, at the Philadelphia and Chicago conventions exceptionally successful meetings were held for the so called practical foundryman. The cupola and steel foundry courses and the round table discussions on nonferrous practice were well attended and considerable interest developed. Past results indicate that the shop courses should be continued at the Cleveland meeting next May, and perhaps enlarged to cover other phases of the industry.

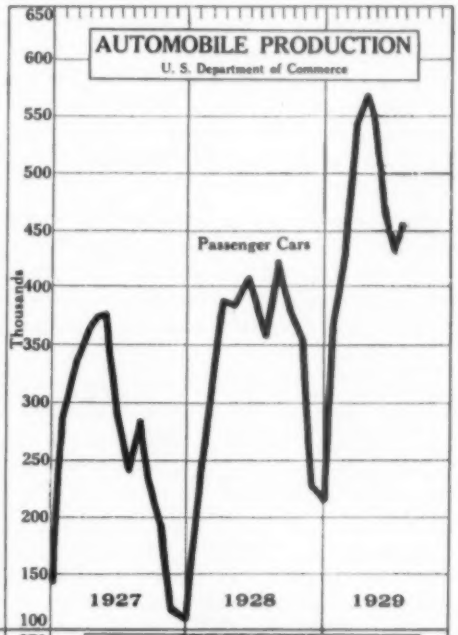
Trade Trends in Tabloid

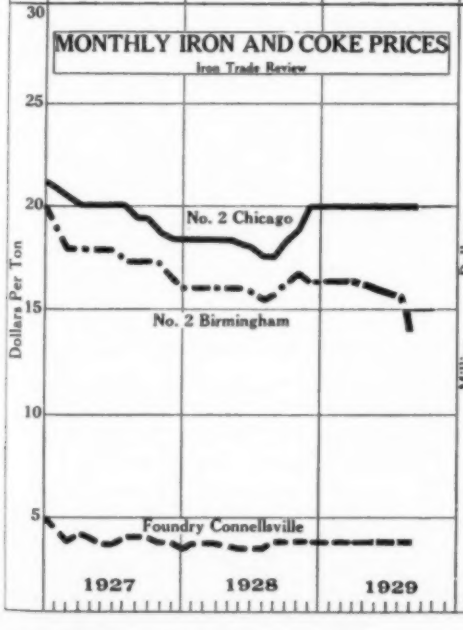
AUTOMOBILE production in August set a new record for that month and was only a fraction of one per cent less than July. However, a decline in output is expected and doubtless will hold the total for the year close to the five and a half million mark which was forecast. Southern cast-iron pipe makers report a slight lull in production although buying is going forward in many centers on the requirements for water and gas extensions. Bookings of steel castings still maintain foundry operations at 65 to 70 per cent. Railway freight car orders in August totaled 2854 cars, bringing the entire number for the first eight months of the year to 66,011 units compared with 29,593 for the corresponding period last year. Steel plant activity has been slightly curtailed, but still is well above the past year. Freight car loadings still continue well above the average for 1928. Jobbing gray iron foundry operations in New England and along the Atlantic coast are slightly lower than during the summer months. However, little change is noted in the Mississippi valley, and as far east as Pittsburgh. Brass foundry operations are satisfactory and sales of ingot metal indicate a belief in continued activity. Stove foundries in the St. Louis district are busy, while sanitary ware shops have a steady rate of operation that has shown a regular increase in unfilled orders since the first of the year.

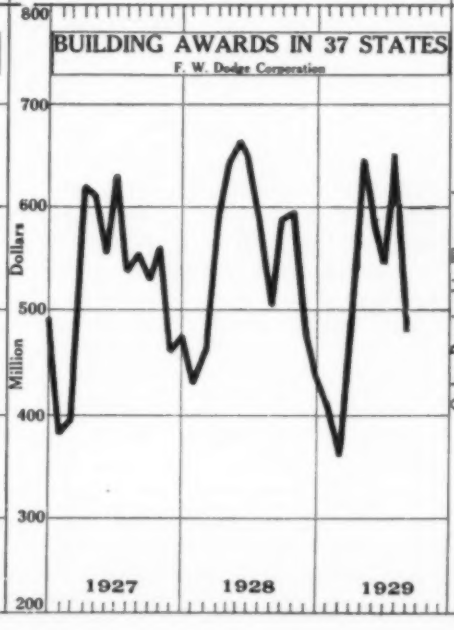
RAW MATERIAL PRICES
Sept. 23, 1929

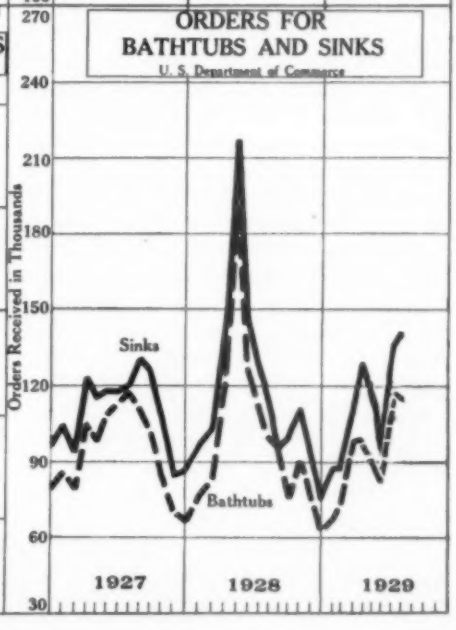
Iron	
No. 2 foundry, Valley	$18.50
No. 2 southern, Birmingham	14.50
No. 2, foundry, Chicago	20.00
No. 2 foundry, Philadelphia	21.76
No. 2 foundry, Buffalo	19.50
Basic, Valley	18.50
Basic, Buffalo	18.50
Malleable, Chicago	20.00
Malleable, Buffalo	20.00
Coke	
Connellsville beehive coke	$3.75 to 4.85
Wise county beehive coke	4.25 to 5.00
Detroit by-product coke	8.50 to 9.00
Scrap	
Heavy melting steel, Valley	$18.50 to 19.00
Heavy melting steel, Pitts.	18.00 to 18.50
Heavy melting steel, Chicago	15.00 to 15.50
Stove plate, Buffalo	13.00 to 13.50
Stove plate, Chicago	11.50 to 12.00
No. 1 cast, New York	12.50 to 13.00
No. 1 cast, Chicago	15.00 to 15.50
No. 1 cast, Philadelphia	16.00 to 17.00
No. 1 cast, Pittsburgh	15.00 to 16.00
No. 1 cast, Birmingham	13.00 to 14.00
Car wheels, iron, Pittsburgh	16.00 to 16.50
Car wheels, iron, Chicago	14.00 to 14.50
Railroad malleable, Chicago	17.00 to 17.50
Malleable, Buffalo	18.00 to 18.50
Nonferrous Metals	**Cents per pound**
Casting, copper, refinery	17.62½
Electro, copper, producers	17.95
Straits tin	45.37½
Lead, New York	6.90
Antimony, New York	8.62½
Nickel, electro	35.00
Aluminum, No. 12, producers	24.30
Aluminum, No. 12, remelt	17.00 to 17.50
Zinc, East St. Louis, Ill.	6.80











Comings and Goings of Foundrymen

Men of the Industry, Whose Activities Are Making Foundry History

JAMES E. EPPLEY, for the past nine years foundry superintendent of the Construction Machinery Co., Waterloo, Iowa, has been appointed foundry superintendent of the Badger Foundry Co., Racine, Wis. In 1919 Mr. Eppley was associated with C. C. Chapel in building and equipping the Montgomery-Ward & Co. foundry, Springfield, Ill. Prior to that he was assistant superintendent at the John Deere Tractor Co., Waterloo, Iowa. Before Mr. Eppley went to Iowa he was superintendent of the Kansas City Hay Press Co., Weber Engine Co. and Smith & Son's Foundries, all of Kansas City, Mo. He also was foundry superintendent of the Duncan Foundry & Machine Works, Alton, Ill. Mr. Eppley is 42 years of age and has been in the foundry business since he was 13 years old. He learned the molders trade in the St. Louis district and was a journeyman molder at 18.

E. Meyers now is foundry superintendent of the Milwaukee Gray Iron Foundry Co., Milwaukee, succeeding Fred Foote, now affiliated with the Prime Mfg. Co., Milwaukee, as foundry superintendent.

Charles F. Glore, Chicago, has been elected a director of the American Brake Shoe & Foundry Co., New York, to succeed George M. Judd, resigned. Mr. Judd remains as secretary of the company.

Arthur T. Morey, General Steel Castings Corp., Commonwealth plant, Granite City, Ill., has been appointed to the department of manufactures committee of the chamber of commerce of the United States.

F. G. Housman, superintendent of the machinery division of Peck, Stow & Wilcox Co., Southington, Conn., has been appointed to serve on the advisory committee of the Connecticut board of education in matters pertaining to foundry training in state schools and industrial companies.

B. D. Claffey, formerly connected with the Spring City Foundry Co., Waukesha, Wis., has been made works manager of the Milwaukee Grey Iron Foundry Co. He has become financially interested in the company and will be in full charge of its foundry.

A. M. Leverich, for eight years Wisconsin representative at Milwaukee of the Abrasive Co., Philadelphia, manufacturer of grinding wheels, has resigned to become general manager of the new eastern plant being completed at Camden, N. J., by the Rundle Mfg. Co., Milwaukee, makers of enameled sanitary ware and plumbing supplies.

H. F. Strotton, general superintendent, Fort Pitt Steel Casting Co., McKeesport, Pa., has resigned from that position. Mr. Strotton and B. W. Miller will operate the Mountain State Steel Foundry, Parkersburg, W. Va. Mr. Strotton will be president and general manager and Mr. Miller will serve as vice president, secretary and treasurer of the company.

G. A. Smith, since 1926 general production superintendent of the Simmons Co., Kenosha, Wis., has been promoted to be general superintendent, succeeding D. C. Travis, who has resigned after a 27-year connection with the company. Mr. Smith joined the company as a foundry worker in 1900, became foreman in 1902 and in 1914 was appointed foundry superintendent, which position he filled until 1926.

Frank Cordes, head of the Lewis Foundry & Machine Co., Pittsburgh, recently absorbed by the Blaw-Knox Co., Blawnox, Pa., has been elected a vice president of the latter company. He continues as president of the Lewis company and becomes a director of Blaw-Knox Co., Pittsburgh Rolls Corp., Pittsburgh, and National Alloy Steel Co., Blawnox, Pa., all of which also were taken over by Blaw-Knox Co. recently. In addition, Mr. Cordes has been made vice chairman of the Union Steel Casting Co., Pittsburgh, and vice president of the National Alloy company. Five other new directors also have been elected by Blaw-Knox, including J. P. Allen, J. R. Dunsford, D. L. Eynon, Samuel Harden Church and C. M. Thorpe. Albert C. Lehman, president of Blaw-Knox, is now chairman of the Board of all subsidiary companies, which consist of Union Steel Castings Co., Lewis Foundry & Machine Co., National Alloy Steel Co., A. W. French & Co. and Pittsburgh Rolls Corp.

Robert G. Guthrie, chief metallurgist of the Peoples Gas, Light & Coke Co., Chicago, who has served as vice president of the American Society for Steel Treating for the past year, has been nominated for the presidency of that organization. He was a member of the board of directors of the society during the years 1925 and 1926 and acted as chairman of the Chicago chapter in 1924-25. He also was chairman of the Chicago convention committee in 1926. Mr. Guthrie specializes in high-power metallography and has attained a national reputation in that field. In 1917 he became identified with the Curtis Aeroplane Co., Buffalo, where he built one of the first large-scale, microscopic laboratories for testing airplane parts. Since that time he has built many high-power cameras and has contributed to technical and professional journals. He became affiliated with the Peoples Gas, Light & Coke Co. about five years ago. Mr. Guthrie has been honored both at home and abroad for his accomplishments in the metal industry.

Ernest V. Pannell, technical adviser to the British Aluminum Co. Ltd. in New York, is leaving America to assume the management of the London Aluminium Co. Ltd., Aston, Birmingham, England. Mr. Pannell was born and educated in London, and is a graduate engineer. His association with the British Aluminium Company has extended over the past 20 years, during which time he served in the various plants of the company. Mr. Pannell formerly had charge of the Toronto office of his company and came to New York in 1919. He has spent the ensuing ten years in developing sales for aluminum and aluminum alloys along engineering lines by personal co-operation with independent foundries, mills and factories throughout the United States. He is the author of a number of articles in various technical journals, among which may be noted the interesting article on cast aluminum automobile chassis which recently appeared in THE FOUNDRY. Mr. Pannell is a fellow of the American Institute of Electrical Engineers, and a member of the corresponding British institution. He has also been an active member of the American Society for Testing Materials, American Institute of Mining Engineers, Society of Automotive Engineers, and other societies.

Robert L. Walker, formerly superintendent of the Atlas Foundry & Machine Co., Tacoma, Wash., has purchased the Johnson Iron Works, Red-

ding, Calif., and has changed the name of the company to Walker Iron Works. Mr. Walker is an experienced foundryman having served as foundry superintendent of the Washington Iron Works, Seattle, Llewellyn Iron Works, Los Angeles, and the Bayer Rothgeb Ornamental Iron Works, Los Angeles. He also was superintendent of the American Marine Iron Works, Portland, Ore., and sales enginener for the Herman Pneumatic Molding Machine Co., Zeleinople, Pa. Mr. Walker will carry on the business of founder, machinist, boilermaker, blacksmith and patternmaker in his new business and will add an electric furnace to the foundry for the manufacture of steel castings. The addition of that furnace will increase the facilities of the foundry which will now be able to make iron, brass, bronze, aluminum and steel castings.

Resigns Vice Presidency

F. B. Caldwell, vice president of the Chicago plant of the Link-Belt Co., Chicago, has resigned that office on account of ill health. W. C. Carter, formerly vice president in general charge of production of all Link-Belt plants, will assume the duties of vice president and general manager of the Chicago plant. E. J. Burnell, formerly manager of the Pittsburgh office, has been appointed sales manager of the Western division with headquarters at the Chicago plant. Nels Davis, formerly of the Chicago engineering sales force, succeeds Mr. Burnell as manager of the Pittsburgh office of the Link Belt Co.

RALPH S. COOPER

Executives Are Advanced

Ralph S. Cooper, formerly vice president and general manager in charge of all departments of the Independent Pneumatic Tool Co., Chicago, has been elected president to succeed the late John D. Hurley. Mr. Cooper was graduated from Cornell university in 1903 where he received a degree in mechanical engineering. He joined the Independent company immediately upon graduation. He served a year in the shops of the company and then joined the sales force at the Pittsburgh office. He was moved to New York as manager of that office and later became Eastern manager. In 1917, Mr. Cooper was elected vice president in charge of Eastern sales and was transferred to Chicago early in 1918 as vice president and general sales manager. He spent 1920 and 1921 in Europe opening the company's office in Great Britain and establishing agencies on the continent. He returned to the United States in 1921 and was appointed vice president and general manager in charge of all departments of the company which office he held until his recent elevation to the presidency. Neil C. Hurley was elected a member of the executive committee.

Foundry Association Directory

American Foundrymen's Association

President, FRED ERB, Erb-Joyce Foundry Co., General Motors building, Detroit; executive secretary treasurer, C. E. HOYT, 222 West Adams street, Chicago; technical secretary, R. E. KENNEDY, 222 West Adams street, Chicago.

Associated Brass Founders of New England

President, J. A. DUNCAN, Wm. Duncan & Sons Co., 166 Liverpool street, East Boston, Mass. Meeting the fourth Wednesday of each month at the Engineers' club, Boston.

The Buffalo Foundrymen

President, J. MCARTHUR, Washington Iron Works; secretary, W. J. WARK, E. J. Woodison Co., 140 Chandler street. Meetings each month at club rooms, 140 Chandler street.

Central Illinois Foundrymen's Club

President, H. M. HIRE, Hire Foundry Co., Peoria, Ill.; secretary, FRANKLIN WHITEHEAD, The Meadows Mfg. Co., Bloomington, Ill.

Chicago Foundrymen's Club

President, H. P. EVANS, Pettibone-Mulliken Co.; secretary, ALBERT N. WALLIN, S. Obermayer Co., 2563 West Eighteenth street. Meetings first Thursday in each month at the City club, 315 Plymouth court.

Connecticut Foundrymen's Association

President, CARL S. NEWMAN, Union Mfg. Co., New Britain, Conn.; secretary CHARLES S. PARKER, Charles Parker Co., Meriden, Conn. Meetings are on second Friday of each month in various parts of the state.

Detroit Foundrymen's Association

President RUSSELL M. SCOTT, Packard Motor Co., Detroit; secretary, WILLIAM J. MUHLITNER, Great Lakes Foundry Sand Co., Detroit. Meet-treasurer, C. E. HOYT, 222 West Adams street,

East Bay Foundrymen's Association

Secretary O. R. MOLLER, Electric Steel Foundry Co. Inc., 1328 Second street, Berkeley, Calif.

Gray Iron Institute

President, WALTER L. SEELBACH, Forest City-Walworth Run Foundries Co., Cleveland; Secretary, ARTHUR J. TUSCANY, Terminal Tower building, Cleveland.

Malleable Iron Research Institute

President, R. R. FAUNTLEROY, Moline Malleable Iron Co., St. Charles, Ill.; secretary ROBERT E. BELT, Union Trust building, Cleveland.

Metropolitan Brass Founders' Association

President WILLIAM EMBER, Jefferson Brass Foundry, 62 Delevan street, Brooklyn N. Y.; secretary, WILLIAM E. PAULSON, Thomas Paulson & Son Inc., 97 Second avenue, Brooklyn, N. Y. Meeting second Wednesday in each month at the Building Trades club, 2 Park avenue, New York.

Newark Foundrymen's Association

President, J. L. CARTER, Sachs-Barlow Foundries, Inc., Newark; secretary W. H. MANTZ, Atlas Foundry Co., Irvington, N. J. Meeting called by president.

New England Foundrymen's Association

President CARL S. NEUMANN, Union Mfg. Co., New Britain, Conn.; secretary, FRED F. STOCKWELL, 205 Broadway, Cambridgeport, Mass. Meetings second Wednesday of each month at the Exchange club, Boston. Outings usually are held in the summer months.

Ohio Foundries Association Inc.

President, C. C. SMITH, Toledo Steel Casting Co., Bancroft and Smead avenue, Toledo, O.; secretary-manager, E. F. SCOTT, 418 Penton building, Cleveland.

Philadelphia Foundrymen's Association

President, C. F. HOPKINS, Ajax Metal Co., Philadelphia; secretary EARL SPARKS, 1623 Sansom street, Philadelphia. Meetings the second Wednesday of each month at the Manufacturers' club.

Pittsburgh Foundrymen's Association

President, L. W. MESTA, Mesta Machine Co., Homestead, Pa.; secretary-treasurer WILLIAM J. BRANT, Wm. J. Brant, Bessemer building, Pittsburgh. Meeting on the third Monday of the month, except in July and August, at Fort Pitt hotel.

Quad-City Foundrymen's Association

President, F. W. KIRBY, John Deere Spreader Works, East Moline, Ill.; secretary-treasurer, J. P. BOADEN, Union Malleable Iron Co., East Moline, Ill. Meetings the third Monday of each month, the meeting place being rotated between Moline, Rock Island and Davenport.

St. Louis District Foundrymen's Club

President, HORACE R. CULLING, Carondelet Foundry Co., St. Louis; secretary-treasurer, LEO J. FILSTEAD, John C. Kupferle Foundry Co., St. Louis.

Southern Metal Trades Association

President, GEORGE B. COCKER, Gastonia, N. C.; secretary, W. E. DUNN JR., Healy building, Atlanta, Ga.

Steel Founders' Society of America

President, J. E. MCCAULEY, Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.; managing director, G. P. ROGERS, Graybar building, New York.

Tri-City Technical Council

Chairman F. V. SKELLEY, Tri-City Railway Co., Rock Island, Ill.; treasurer, MAX SKLOVSKY. Deere & Co., Moline, Ill. Combined meetings held only one or two times a year on call.

Tri-State Foundrymen's Association

President, WILLIAM HOPPENJANZ, The Star Foundry Co., 221 Main avenue, Covington, Ky.; secretary, GEORGE W. PIEHL, Wessling Bros. Foundry Co., 1607 McLean avenue. Meetings the second Thursday of each month at the Cincinnati club, Eighth and Race streets.

Twin City Foundrymen's Association

President, WILLIAM E. LOBERG, American Hoist & Derrick Co., St. Paul; secretary-treasurer, C. E. LANGDON, 3849 Lyndale avenue, south, Minneapolis. Meeting third Wednesday of each month at Athletic club.

Washington Foundrymen's Club

President, J. W. ORPHAN, Lake Union Foundry Co., 1703 Westlake avenue, Seattle; secretary, EDWARD C. GUSTIN, The Prescott Co., 1 West Lander street, Seattle. Meetings second and fourth Tuesdays of each month at the Elks Temple, Fourth avenue and Spring street.

Obituary

Harry E. Kies, whose death was noted in the Sept. 1 issue of THE FOUNDRY, formerly was connected with several malleable iron foundries in various positions. Mr. Kies began his career by early entering the employ of the Erie Malleable Iron Co., Erie, Pa., and was advanced to foreman and finally superintendent. In 1912 he became connected with the American Radiator Co. and was sent to Germany to complete the erection of its malleable foundry at Neuss-am-Rhein. He conducted the foundry until the outbreak of the war when he returned to the United States. Shortly after he supervised the construction of a large malleable iron foundry at Buffalo for the American Radiator Co. In 1921, Mr. Kies erected and managed a malleable foundry at Jamestown, N. Y. and continued operation of that plant until May, 1925 when he again became associated with the American Radiator Co. He was sent to France and built and put in operation a 50-ton malleable plant for that company. After two and a half years he returned to America and was made executive manager, malleable iron department, of the Buffalo plant of the American Radiator Co.

W. Charles Lipe, president of the Globe Forge & Foundries Inc., Syracuse, N. Y., died Aug. 16.

Richard H. Verian, 74, president of the Enterprise Foundry Co., Rochester, N. Y., died recently in his home. He had been head of the company for near half a century.

Col. Albert G. Mills, senior vice president of the Otis Elevator Co., New York, with which interest he was associated for 52 years, died at his summer home in Falmouth, Mass., Aug. 26. He was 85 years old.

James F. Conran, formerly general sales manager of the Standard Sanitary Mfg. Co., Pittsburgh, died at Poland Spring, Me., Aug. 30, where he was spending the summer. He was 67 years old and had been in ill health for several years.

Ray P. McGrath, for 15 years manager of the San Francisco office of the Sullivan Machinery Co., Chicago, died recently. He had been associated with the company since 1906. Prior to 1914 he was identified with the New England sales office at Boston.

John David Hurley, president and founder of the Independent Pneumatic Tool Co., died Aug. 15, at his home at the Edgewater Beach hotel, Chicago. Mr. Hurley was born in Simsbury, Conn. At an early age his parents settled in Galesburg, Ill. After leaving school, he became identified with the Chicago, Burlington & Quincy railroad and later with the Louisville & Nashville railroad at Louisville, Ky. About 1898, he and his brother, Edward N. Hurley Sr., organized the Standard Pneumatic Tool Co. Mr. Hurley sold his business in 1902 and became identified with the Rand Drill Co., New York. In 1905, Mr. Hurley returned to Chicago and organized the Independent

JOHN D. HURLEY

Pneumatic Tool Co. in which he retained an interest until his death.

George W. Thomson, midwest district manager of Norton Co., Worcester, Mass., died Aug. 22 at Chicago after a brief illness. He had served the Norton Co. for 31 years, being employed successively as head of its billing department, as salesman in the Connecticut and Philadelphia territories and since 1915, as district manager for the grinding wheel division with headquarters in Chicago.

Claude V. Marks, secretary, treasurer and director of the Ohio Brass Co., Mansfield, and Barberton, O., and Niagara Falls, Ont., manufacturer of electric railroad equipment, automobile parts, etc., disappeared Sept. 9 from the steamer HOMERIC on which he was traveling to Europe in company with C. K. King, president of the company. Company and steamer officials expressed the belief that in some accidental way he fell overboard, since a thorough search of the ship failed to locate him. Mr. Marks also was secretary, treasurer and director of the Ohio Insulator Co., Mansfield, O., and the Canadian Ohio Brass Co. Ltd., Niagara Falls, Ont.

Cohesibility of Sand

(*Concluded from Page* 843)

is widened or flared with tools its surfaces are roughened owing to the disturbance of the grain. This defect will be demonstrated by using gates, formed with tools. If the gate has been pressed or rammed by a pattern exactly reproducing its form, it will be noticed that the runner on the casting is perfectly smooth and that the down gate consequently has suffered no alteration.

In all the parts of the mold, from the runner to the riser, everything should be done to leave the mold in the condition in which it was rammed. Everything possible should be done to avoid retouching and mending. Care should be taken to maintain its cohesibility unimpaired.

Institute Issues Book

Gray Iron institute, Terminal Tower building, Cleveland, has released to its members a book indicating over 2000 uses for gray iron castings. A. J. Tuscany, manager of the institute, also advises that he has completed arrangements whereby it will be possible to present information on the uses and properties of gray iron for different purposes. One phase of this work will consist of addresses to groups of industrialists, engineering societies, technical bodies and national and local organization. Those interested in having addresses on gray iron presented to their groups may write to the Gray Iron institute, Terminal Tower building, Cleveland, and speakers with particular experience in the organization's special interest will be made available.

Asks Practice Conference

The Nonferrous Ingot Metal institute, Chicago, will make application to the federal trade commission for a trade practice conference. The place and date will be left to the trade commission, but the conference probably will be held in Washington. It is hoped that it will be called in October or November.

Lewis-Shepard Co., 577 East First street, Boston, has purchased a brick building containing approximately 60,000 square feet of floor space at Crawfordsville, Ind. That building will be operated as a branch plant which will serve customers west of the Cleveland district. At first the Crawfordsville plant will be used for the production of skid platforms for lift trucks and storage racks for use with portable elevators.

Electrochemists Meet

Aluminum and magnesium alloy castings are playing an important part in the development of the aircraft industry, it was pointed out at the fifty-sixth general meeting of the American Electrochemical society held at Pittsburgh Sept. 19, 20 and 21. More than 300 were registered at the convention, the program of which, in addition to the presentation of a number of technical papers, included visits to several manufacturing plants in the district.

A large portion of one of the three technical sessions was given over to discussion of the uses of magnesium, aluminum and their alloys in aircraft. Dr. J. D. Edwards, assistant director of research, Aluminum Co. of America, presided at this meeting. Discussing aluminum and aluminum alloys, T. W. Bossert, Aluminum Co. of America, stated that castings of heat treated aluminum alloys are employed to a large extent in aircraft engines, and were it not for these metals the low weight horsepower ratio obtainable would not be possible. The weight of aluminum used in aircraft engines amounts to 50 to 60 per cent of the total engine weight, depending on whether it is of the air or water cooled type.

In the latter type, aluminum alloys are used generally for the following parts: Cylinder block, cylinder heads, crankcase, oil pan, gear housings and pistons. In air-cooled engines, of which the majority are the radial type, the crankcase, cylinder heads, rocker boxes, rocker box covers, nose piece, supercharger and pistons are aluminum alloys. Pistons of both types also are of aluminum alloy.

Magnesium, because it is lighter even than aluminum, is finding growing application in aircraft, particularly since recent discoveries of methods of purification and heat treatment of magnesium alloys have overcome most fabricating obstacles, it was stated in a discussion on "Magnesium and Its Alloys in Aircraft," by W. G. Harvey, Aluminum Co. of America, Cleveland. The most useful magnesium products for aircraft construction were declared to be magnesium castings, since they offer an opportunity for a substantial reduction in weight. Almost any casting that can be made in aluminum can be cast in magnesium, due to the improvements and simplifications of foundry practice. Since magnesium reacts with water at a high temperature it has been necessary to develop special sand mixtures and methods of molding to produce successful castings. Casting in permanent molds has not been satisfactory commercially but progress is being made with experiments.

"Recent Developments in the Annealing of Nonferrous Metals," a subject introduced by Robert M. Keeney, Connecticut Light & Power Co., involved discussion emphasizing changes in fuel for heating furnaces in treating nonferrous metal products. It was stated that although oil continues the leading fuel and appears destined to hold this position for some time, electricity and gas are coming to the front. Current installations of electric furnaces in the nonferrous industry are roughly estimated as totaling 15,000 kilowatts. Summing up the discussion on the choice of fuel, Mr. Keeney stated that local economic conditions are important factors in this selection.

Institute Starts Uniform Accounting Division

Realizing that uniformity in accounting is essential to rational cost finding, the Gray Iron Institute, Terminal Tower building, Cleveland, has established a division of uniform accounting to be directed by E. E. Pilgram. Mr. Pilgram has had a wide experience in this class of work both in private practice and among such trade groups as the Tent and Awning association and the Common Brick Manufacturers' association with which he has been active for a number of years.

A. J. Tuscany, manager of the institute in commenting on this new activity of the institute, said "Our studies of the subject of proper costs have shown the necessity for proper accounting methods to substantiate and provide a basis for intelligent costs and prices. The most effective plan is for the director of our division of uniform accounting to travel throughout the country calling on member companies to advise with them and their accounting men on proper procedure. Where desired, members of our staff will follow along and make actual installations and otherwise assist members."

"This additional activity of the institute is not intended to conflict in any way with the effective work done along the lines of gray iron foundry costs by others in the field, but rather to supplement and make this work more effective."

The cost committee of the institute, of which John L. Carter, Sacks-Barlow Foundry, Inc., Newark, N. J. is chairman, has been responsible for setting up the uniform accounting division. This committee has completed a standard accounting and cost finding procedure for the gray iron industry, which now is being printed and will be made available for the industry.

Southern Metal Trades To Meet in October

Southern Metal Trades association, will hold its annual convention at Knoxville, Tenn., Oct. 16 and 17, it is announced by William E. Dunn Jr., Georgia Savings Bank building, Atlanta, Ga., executive secretary. The principal business will be the election of officers for the coming year. The present officers include George B. Cocker, Gastonia, N. C., president; John S. Schofield, Macon, Ga., first vice president; William E. Dunn Jr., Atlanta, secretary, and W. G. Mealor, Gainesville, Ga., treasurer. Several addresses on topics of a technical nature relating to foundry and machine shop operation, will be made by men nationally known in this industry. The full program has not been completed.

Announces Program

The tentative program for the Toledo meeting of the Ohio Foundries Association Inc. has been announced by Elmer F. Scott, secretary-manager. The meeting will be held at the Toledo Yacht club, Oct. 10. This is the annual meeting for the election of board members and the transaction of business. L. P. Robinson, Werner G. Smith Co., Cleveland, will address the meeting on "What Has Become of the Foundryman's Share of the American Dollar," and E. J. Lowry, consulting metallurgist, Detroit, will speak on "Advance in Foundry Practice." Registration at the Toledo Yacht club will begin at 10:30 and luncheon will be served at noon.

Quad-City Group Meets

The regular September meeting of the Quad-City Foundrymen's association was held Sept. 16, at the Davenport chamber of commerce, Davenport, Ia. A. E. Hageboeck, Frank Foundries Corp., Moline, Ill., was the speaker of the evening and gave a talk on the Third International Foundrymen's congress and on his observations concerning foundry practice in Europe. He also showed several reels of moving pictures taken during his trip.

General Syndicate of Belgian Foundrymen will participate in the industrial exhibition which will be held at Liege in 1930 on the occasion of the centenary of the independence of Belgium.

What the Foundries Are Doing

Reflecting the Activities of the Gray Iron, Malleable, Steel and Brass Shops

Woodruff & Edwards Co., Elgin, Ill., suffered a slight damage to its foundry by fire recently.

Haynes Stellite Co., Kokomo, Ind., is contemplating the construction of a foundry addition, 75 x 132 feet, in the future.

Standard Brass & Mfg. Co., Port Arthur, Tex., has increased capitalization to $100,000 to provide for improvements.

Service Foundry Inc., New Orleans, has been incorporated with $100,000 capital, by Morris J. Rabe, 3923 Orleans street.

Lamb-Gray Harbor Co., Hoquiam, Wash., has purchased the Raymond Foundry & Machine Co., Raymond, Wash.

Cleveland Hardware Co., 4518 Lakeside avenue, Cleveland, has installed a die casting department in its Lakeside avenue plant.

Cast Products Corp., New York, has been incorporated with $20,000 capital, by J. A. Levner, 1440 Broadway, N. Y.

Warman Steel Casting Co., 6100 South Boyle avenue, Vernon, Calif., has filed plans for a 1-story foundry addition.

Gardner Denver Co., Quincy, Ill., has let the contracts for a new addition to its plant that will increase the production 50 per cent. The building is expected to be finished in 90 days.

Faith Mfg. Co., 2531 North Ashland avenue, Chicago, manufacturer of die castings, is taking bids for the construction of a 2-story plant addition.

Detroit Stoker Co., General Motors building, Detroit, plans construction of a 2-story addition to its pattern shop also an addition to its foundry which will double the present capacity.

Missouri Boiler & Sheet Iron Works, Papin and Twenty-third streets, St. Louis, acquired property including a 1-story building, which will be enlarged for a foundry.

Gogan Machine & Foundry Co., 1440 East Fifty-fifth street, Cleveland, has purchased additional land at East Fifty-fifth street and Spencer avenue.

Hoosier Iron Works and the Kokomo Malleable Iron Works Inc., both of Kokomo, Ind., report business good. These firms specialize in automotive castings.

Apex Brass Foundry Co., 1925 Elston avenue, Chicago, has been incorporated with $5000 capital by Arthur Goldberg to engage in the foundry and machine shop business.

The north wing of the Gering Foundry & Machine Co., Gering, Nebr., plant was recently damaged by fire. Estimated loss was about $15,000.

American Cast Iron Pipe Co., 2930 North Sixteenth street, Birmingham, Ala., has been issued a permit for the construction of a dust building and a core head building.

Nutmeg Crucible Steel Co., Branford, Conn., is planning the construction of a 1-story foundry, 70 x 100 feet, which will cost approximately $20,000.

Hill Clutch, Machine & Foundry Co., 6400 Breakwater avenue, Cleveland, has plans for the construction of a 1-story plant addition, 49 x 92 feet.

Adams Foundry Co., 960 North Ninth street, Philadelphia, has been incorporated with $5000 capital by James B. Clarke, 6220 Homer street, Philadelphia, to manufacture castings.

Erie Malleable Iron Co., Twelfth and Cherry streets, Erie, Pa., is building an addition to its automotive wheel division, which will double present floor space. It is expected production will be under way by Oct. 1.

Massey-Harris Co. and Wiard Plow Co., both of Batavia, N. Y., have formed an agreement which will give the former control of the output of the latter. Each firm will retain its complete identity.

Florence Pipe Foundry & Machine Co., Florence, N. J., has asked bids on a general contract for a 1-story addition. The building and equipment will cost about $35,000.

St. John Iron Works, St. John, N. B., subsidiary of the St. John Dry Dock & Shipping Co. Ltd., will build a foundry upon the site of the present Lower Cove plant.

Northwestern Motor Co., Starr avenue, Eau Claire, Wis., has let the contract for a 1-story foundry addition, 42 x 125 feet, to Olson & Walker Co., Eau Claire.

General Electric Co., Schenectady, N. Y., has closed the foundry department of the Ft. Wayne, Ind., plant and is disposing of the equipment.

Ideal Foundry & Machine Co., recently organized, is operating a foundry at 900 Albany street, Dayton, O., manufacturing gray iron and semisteel castings. J. M. Conroy is president of the company.

Capitol Foundry, Mystic, Conn., recently opened by F. W. Stickles, will specialize in gray iron castings. Mr. Stickles formerly operated a foundry under the same name at Hartford, Conn.

Warren Foundry & Pipe Co., 201 Devonshire avenue, Boston, has plans for the construction of a foundry and warehouse addition. French & Hubbard, 210 South street, Boston, are engineers.

United Brass & Aluminum Mfg. Co., South Park street, Port Huron, Mich., will rebuilt that portion of plant recently damaged by fire, according to Jacob Goldman, president. Estimated loss was about $30,000.

North Shore Foundry Co., North Chicago, Ill., recently incorporated, is planning a 1-story foundry which will cost about $50,000. About $30,000 will be expended for equipment for the new building. (Noted Sept. 1.)

Ardent Furnace Co., Blanchester, O., will start production shortly in its new plant, in which it will build its new type of furnace designed to minimize smoke emission. (Noted June 15.)

Williams Foundry & Machine Co., division of the National-Erie Co., Erie, Pa., manufacturer of rubber machinery and repair equipment, has completed its new plant at Erie, which will give much enlarged production.

Hartig Plow Co., Evansville, Ind., has changed its name to the Hartig Foundry Co. That firm has engaged in the gray iron foundry business for the past five years and has specialized in the manufacture of water backs and gas burners.

International Equipment Co. of Texas, Beaumont, Tex., formerly the Boyken Machinery & Supply Co., recently acquired by the International Derrick & Equipment Co., Columbus, O., is adding a number of new plant buildings including a steel foundry.

Semi-Steel Test Foundry Co., 4916 Bloomingdale avenue, Chicago, has two new foundry buildings under construction to supplant that part of its plant which recently was destroyed by fire. Abell-Howe Co., 53 West Jackson boulevard, Chicago are the contractors.

Liberty Range Works, Nashville, Tenn., will begin work on a new $250,000 plant located on Forty-eighth avenue between Centennial boulevard and Tennessee avenue, West Nashville, Tenn. The new building will be 50 x 640 feet and will be built parallel to a spur track.

Saginaw Foundries Co., 930 Water street, Saginaw, Mich., recently incorporated to take over the plant and business of the A. F. Bartlett Co. will add a steel foundry department before January. New equipment will be installed. Fred W. Stork is in charge of operations. (Noted Sept. 15.)

McWane Cast Iron Pipe Co., 3700 North Eleventh avenue, Birmingham, Ala., has awarded the general contract to A. F. Felix, 2119 North First avenue, for a 1-story and basement addition, 40 x 100 feet. The building and equipment will cost about $40,000. Miller & Martin Title & Guarantee building, are the architects. (Noted Sept. 1.)

International Steel Co., Canton, O., recently incorporated, which leased the plant of the former Canton Steel Foundry Co., Allen avenue southeast, from Darwin Luntz, care Luntz Iron & Steel Co., Harter Bank building, is expected to begin remodeling the plant within 60 days. Additional equipment will be installed. (Noted Aug. 1.)

Charter has been granted the Ellison Bronze Co. Inc., a New York corporation, with its principal office in Richmond, Va., to manufacture and produce brass, bronze and metal castings. Henry W. O'Grady is the agent in charge of business. Maximum capital stock is $60,000. A. C. Nordstrom of Jamestown, N. Y., secured the certificate of authority.

Bucyrus-Erie Co., South Milwaukee, Wis., has completed acquiring Ruston & Hornsby Ltd., of Lincoln, Eng., an established English concern. Ruston-Bucyrus Ltd. is being formed to represent the company in England. Each of the component companies will hold equal stock in the company. W. W. Coleman, president of the Bucyrus-Erie Co., will be chairman of the board.

Wisconsin Ornamental Iron & Bronze Co., 1665 Booth street, Milwaukee, recently merged with the General Bronze Co., Long Island City, N. Y., has let the general contract to S. M. Siesel Co., 160 Ogden avenue, Milwaukee, for a 1-story addition to its brass foundry, 75 x 116 feet. The building and equipment will cost about $40,000. E. A. Ernest is president. (Noted Sept. 15.)

Traction Foundry & Machine Co., LaPorte, Ind., is installing equipment in an industrial building which has been unoccupied the greater part of ten years. In addition to general manufacturing and jobbing of gray iron castings, the company will supply the Superior Steel & Malleable Castings Co., Benton Harbor, Mich. Directors are the same in both companies. (Noted Sept. 15.)

Campbell, Wyant & Cannon Foundry Co., Muskegon, Mich., reports that the tonnage of cylinder block castings shipped so far this year has exceeded the total of 68,268 tons shipped in 1928. Although the company has increased its capacity two and one half times in the past three and one-half years, it is still unable to handle all the business available and plans further additions.

Stockholders of the LaCrosse Plow Co., LaCrosse, Wis., have voted approval of the sale of the business to the Allis-Chalmers Mfg. Co., Milwaukee. The LaCrosse company makes plows, harrows, disks, drills and cultivators, and was acquired to round out the Allis-Chalmers farm implement line marketed by the United Tractor & Equipment Corp. The LaCrosse concern was established in 1893 and has plant facilities of ten buildings with eight acres of floorspace. B. C. Smith is general manager.